

# AVIATION

The Oldest American Aeronautical Magazine

McGraw-Hill Publishing Company, Inc.

In this Issue  
AIR ROLE ADVANCED  
IN NEW ARMY

APRIL  
1942

Price 50¢ per copy



## *Wildcats in Action*

"... In a recent engagement between Japanese land-based aircraft and Grumman Wildcat carrier-based fighters, a total of ten Japanese fighters and three bombers were destroyed without a single loss of our own planes."—Secretary Knox. These Wildcats, like all other Grumman F4F's in Navy service, are powered by Pratt & Whitney Twin Wasps.



**PRATT & WHITNEY AIRCRAFT**  
EAST HARTFORD, CONNECTICUT  
ONE OF THE THREE DIVISIONS OF UNITED AIRCRAFT CORPORATION



## "Going Up!" a mile a minute

•The new enterprise plants being built in the United States are the most advanced in the world. They are being planned to meet all the needs of the future. They are being planned to meet all the needs of the future. They are being planned to meet all the needs of the future.

The leaders of aircraft and aviation in the United States are in forefront with the rest of the world. They want to build better planes—build them faster than ever before, and build them better than the best ever.

The 13,000 men and women of the Thompson Products Corporation are working to meet this demand. They know that the aircraft of the future must be built on today's most advanced production standards. They know that the aircraft of the future must be built on today's most advanced production standards.

**THOMPSON PRODUCTS INC.**  
A Division of General Motors Corporation  
Aircraft Division, 4800 E. 12th Avenue, Detroit, Michigan 48202

Manufacture of aircraft and aircraft components. Also, manufacture of aircraft and aircraft components. Also, manufacture of aircraft and aircraft components.



Industrial of the current plant of the production effort of the aviation industry in this great \$200,000,000 plant built by the Hercules Press Company for aircraft production. The rubber press and other machinery by E. F. Goodrich, weight 4000 pounds.

George W. Phil  
Ludwig E. Weyl  
Charles E. F. Weyl

Arthur W. Weyl  
E. Eugene Miller  
Stiles Stahlhof  
W. W. MacDonell  
Paul Weyl  
Sally Altschul

On Leave of Absence from General Services  
Carl Weyl  
Charles E. F. Weyl  
Joy P. Weyl  
Sally Altschul  
One Day

MAGNAN-HEIL, PUBLISHING CO. INC.

1000 Broadway, New York 10019  
1000 Broadway, New York 10019  
1000 Broadway, New York 10019  
1000 Broadway, New York 10019  
1000 Broadway, New York 10019

1000 Broadway, New York 10019  
1000 Broadway, New York 10019  
1000 Broadway, New York 10019  
1000 Broadway, New York 10019  
1000 Broadway, New York 10019

MOBILE EDITION

In This Issue	5
Editorial Page	61
AVIATION'S War Communique No. 4	82
Achieves Makes Good Neighbors	84
Healthy Workers Produce More	86
German Aircraft	87

## AVIATION MANUFACTURING

Production-Design-Research-Engineering	87
Control Methods of Flightless Installation	88
New Gas Tank Installation Feature	89
Designing Propellers to Meet Performance Requirements	90
Harold H. Warden	90
Producing Shells for the F-30	91
Walter G. Ward	91
Design Charts for Tubes Subjected to Bending	92
Walter C. Chyten	92
Clearing Aids for Production	93
Solving Power in Engine Testing	94
Strength Analysis of Elongated and Bolted Joints	95
Wayne A. McGowan	95
Enter Weyl Variable Pitch Propeller	96
Synthetic Resins in Construction, Part II	97
H. M. Haul	97
De Havilland Controls-Retarding & Blending Propeller	98
Bladder Protection from Skrapel	99
Review of Aviation Patents	100
AVIATION'S Sketch Book of Design Data	101

## NEW PRODUCTS

New Products and Equipment for the Aviation Industry	102
Window Shopping	103

## MAINTENANCE

Producing Maintenance Men	104
W. C. Erb	104

## UTILITY

Damage Returns over Land and Sea	105
J. L. Whiddington	105

## AIR TRANSPORT

Airline Air Conditioning	106
Ward Franks Manager for Northwest Airlines	107
Brown's Auxiliary Air Base	108
Earl Harvey	108

## FLYING EQUIPMENT

The Security Anchor	109
Side Slip	110
Aviation's Long Tea Road	111
AVIATION'S Radio Page	112
W. W. MacDonell	112

## THE AVIATION NEWS

Notable Aviation	113
Ward Franks	114
Aviation's Long Tea Road	115
Aviation's Radio Page	116
Aviation's Long Tea Road	117
Aviation's Radio Page	118



## Pioneer Precision

faithfully indicates the  
"ups and downs" of flight

Rate of climb (or of descent) is something a man needs to know when he's flying a modern high-performance airplane. And he wants to be able to ascertain it accurately in one swift glance. That is why pilots esteem the Pioneer Sensitive Rate-of-Climb Indicator so highly. It is the most advanced instrument yet developed for the purpose. It is free of erratic service and maintenance requirements of older instruments and is most reliable. . . In short, a true Pioneer Instrument. It adds appreciably to our nation's One Big Job—in "Keep 'em flying."

# Pioneer INSTRUMENT

DIVISION OF BENDIX AVIATION CORPORATION • BENDIX, NEW JERSEY



## ★ ★ IN THIS ISSUE ★ ★ ★ ★ ★

**FINANCIAL DEVELOPMENTS** looked large in the aviation picture during the last month. In a discussion of the significance of these developments the last editorial (page 31) points out that a number of aviation manufacturers are adding sizable new net against the expenses of their inevitable transition from war to peace time operations. We believe that this practice of generously allowed will seriously the process or consequences of the industry after the war.

Aviation's War Communique No. 4 continues our running commentary on an power in this war. It reports development was the complete reorganization of the U. S. Army giving air power equal status with the ground forces, and the taking in the Navy command which placed a flying school at the head of operations.

### GOOD NEIGHBORS

The way in which airlines are creating transatlantic relations is described in a story by Leonard E. Reed, who

graphs and illustrates of many planes, many of which have not been presented previously to the public. Aviation shows three full pages of German aircraft (pages 37, 38, and 39).

### AIR'S 50 PRODUCTION

The Manufacturing Section of Division leads off with a complete and an illustrative article by Dr. D. S. French of the Bristol Aircraft Co. on current methods of Douglas production (page 62). Illustrations and sketches, as well as a color photograph of the test. It should prove of considerable assistance to design engineers and production men in achieving maximum efficiency in construction of transport planes.

Comparing Propellers to Main Engine Requirements (page 70) by Harold H. Menden of Curtiss-Wright's Propeller Division, describes those factors that are considered in coordinating propeller design with engine design. The complete report of an investigation of the production of wings for the Lockheed P-38 Interceptor Pursuit is described in an article by W. G. Ward (page 74).

The first of a series of articles by Walter C. Clayton, chief engineer of the Curtiss-Wright Technical Institute, on design charts for radial engines begins on page 80. Design engineers will welcome these short cuts for determining wall thicknesses of tubes subjected to bending to yield a desired margin of safety. Later articles will deal with tubes subjected to shear and torsion.

G. B. Connel of General Electric's Industrial Engineering Division presents a practical method for salvaging part of the enormous energy generated in testing aircraft engines (page 88). Part I of an article describing the method by which the strength of riveted and bolted joints is calculated begins on page 91. This series has been prepared by Wayne A. McDermott, senior



Frank T. Courtney

stress analyst of Consolidated Aircraft. How good maintenance men are being trained on to release the military aircraft and commercial airplanes is described in a story on the Roosevelt Aviation School (page 114).

J. A. Tamm of Northwest Airlines describes the equipment used by Northwest in air conditioning the passengers during their layovers on the map between flights (page 116).

## Coming

Frank T. Courtney, whose colorful history in a star and engineer is well known to most aviation people, has prepared a pre-emptive article on remote propeller driven and related some conclusions based on his sound experience which will furnish more interesting to many fellow engineers.

The accompanying photograph, contributed from Aviation's early film, shows him as he looked in 1927, then a captain in Britain's Flying Corps. The prelude article on aluminum construction is also scheduled for May along with the usual complement of production, design, research and engineering articles of immediate importance.



Harold H. Menden

voluntarily points out that the strength of our bonds with our neighboring republics to the south after the war effort is needed will depend on resources rather than political considerations (page 30). Comparing our series of articles designed to assist management of aviation production plants, here begins on page 56 an article which demonstrates the importance of improved health, education, recreational facilities, sanitation, and nutrition in any program designed to assist aviation.

Adding to our collection of photo-



G. B. Connel

**18,400 spot welds in  
7½ HOURS  
—on aluminum alloys**

Typical installation of a Smith resistance-welding machine with G-E rectifier control which has welded the Glenn L. Martin Company to make a total of 18,400 spot welds in 7½ hours.

## GET CONSISTENT, HIGH PRODUCTION WITH G-E IGNITRON RECTIFIERS on inductive-type stored-energy welding

**PROVED** by more than 18 months of actual use in supplying power to inductive-type, stored-energy welding machines, G-E ignitron rectifiers are helping users get fast, dependable operation—particularly in the aircraft industry.

Because of its low loss demand, the inductive type of stored energy resistance welding permits the use of low cost plant distribution systems and reduces voltage drop. It also permits installation of welding machines at the most favorable point in the production line—even though this may be at some distance from the distribution transformers.

Good voltage regulation afforded by the low loss demand also reduces the possibility of light flicker and limits interference with other welding equipment on the same circuit.

Designed by outstanding electronics engineers, these G-E rectifiers are built for ease of installation and low maintenance. Whatever your problem or control for resistance welding—consult your nearest G-E office. Our control specialists will be glad to work with you. General Electric, Schenectady, N. Y.

General Electric  
and its employees  
are proud of the many medals of  
excellence made by the U.S. Navy for  
the production of naval aircraft.

**GENERAL ELECTRIC**

**IDEAL FOR CIVIL AIR PATROL AND PILOT TRAINING**



### The PIPER Sea Scout with Plywood Floats

**FREE CATALOG** showing all the new Piper planes may be obtained from your Piper Dealer. Or, if you wish, we will gladly send you one of these handouts, deluxe catalogs which portray all the new Piper ships in full colored color, providing you endless life in images or even for postage-handling. Piper Aircraft Corporation, Department ADL, Lock Haven, Pennsylvania, U. S. A.

**THE** practicality of seaplane flying is taken out of the luxury class with the new Piper Sea Scout. Interchangeable floats of plastic plywood, externally braced, double the utility of this ship, for the floats are quickly interchangeable with the plane's regular wheel landing gear. All parts are completely installed to protect from salt water corrosion. The Piper Sea Scout is the perfect plane for Civil Air Patrol of America's coastlines and waterways. It is the ideal seaplane pilot trainer . . . low in cost, easy to fly and most economical to operate. Ask your Piper Dealer about the new Piper Sea Scout and have him tell you about the free course of dual flight instruction offered the purchaser of any one of the new Piper planes.



**PIPER**

POINTS THE WAY TO WINGS FOR ALL AMERICA

AVIATION, April, 1962





## AIR Superiority is not a matter of numbers alone

In neither war nor commerce is air superiority solely a matter of numbers. Skill contributes no small part to air superiority, skill of the designer, manufacturer and pilot.

The skill of engineers who design and of manufacturers who build the precision machines which produce a ship's component parts contributes to air superiority, too.

HALL high precision valve and valve seat grinders are doing their part in building air superiority for America and her allies in the rapid production and speedy maintenance of all types of airplane engines for war and commerce.

HALL engineers will gladly co-operate with you on your valve and valve seat grinding problems or will furnish you with complete information on HALL equipment now in use in practically every field of aircraft engine production or maintenance. Write today.

**THE HALL MANUFACTURING CO.**  
TOLEDO, OHIO, U. S. A.

• Above is AWA  
Wet Type Universal  
ECCENTRIC  
Valve Seat Grinders  
in use on radial  
cylinders. Right  
is AWA wet type  
ECCENTRIC in  
use on radial  
cylinders.



# HALL ECCENTRIC SEAT GRINDERS



# SPEED

## ... as essential in the plant as in the air

Screaming through the skies, today's aircraft fly at almost incredible speeds. But to win the war—America must do more than make *faster* planes. It must *make them faster*. Production lines must back up fighting lines. Industry *must* produce more. It *will* produce more. At McDonnell, we are proud to be a part of our nation's great war effort. Our workmen, designers, and engineers are straining plant capacities to present limits, in the production of *precision-built* aircraft and parts for our armed forces.

## MCDONNELL AIRCRAFT CORPORATION

LAMBERT FIELD ★ SAINT LOUIS

# "Lightning" STRIKES AT 450 M.P.H.!



Lightning  
P-51  
Microgrip-Fafnir

DESIGN "Lightning" by the R.A.F.—this sleek, powerful ship is one of the deadliest fighters in the sky! Its phenomenal speed and maneuverability, particularly at high altitudes, are accomplishments of engineering genius and high structural efficiency. Controlability is made possible and insured by a safe, positive, friction-free control system—with Fafnirs at the vital points of motion!

Fafnir Aircraft Ball Bearings belong to the aircraft industry. You'll find them on the controls of

the Army's fast pursuits, the Navy's fighters and bombers, the ships that America sends to the R.A.F. —and on the great commercial airliners. Fafnirs are the products of the combined engineering knowledge of the leading aircraft builders, and Fafnir's own wealth of technical and producing experience. Made in a factory where a quarter of a million dollars was spent on the equipment to test them and perfect them. The Fafnir Bearing Company, Aircraft Division, New Britain, Conn.

**FAFNIR**  
Ball Bearings  
for  
Aircraft Engines and Controls



## WHEN THEY'RE TOUGH TO GET TO...



## THESE *Cupforged* TOOLS WILL DO THE JOB

Designed with angular offsets of 75°, 10° and 15°, these Aero Tool Cupforged Offset Rivet Sets provide accessibility for setting rivets in out-of-the-way locations—where they're tough to get to.

Like the many other production tools by Aero Tool, these rivet sets are machined and coated to exacting standards from tough heat-treated steel. Microglass polished and solvent treated. Computer inspection, CUPFORGING assures an even metal flow and structure for longer wear and extreme precision. MICROGLASS POLISHING guarantees a glass-smooth face that can't harm aircraft skins or other surfaces the tools contact. COMPANIMATE INSPECTION assures dimension-

al accuracy and surface perfection.

It's the constant attention to detail—the "make it better or don't make it" policy that accounts for the wide acceptance of Aero Tool production tools by leading aircraft companies—every tool from Aero Tool is designed to do its job better, faster, easier, longer.

Send today for your free letterhead, please for the new 26-page illustrated catalog describing many designs of Standard, Offset and Special Rivet Sets, Squeezer Sets, Bucking Bars, Precision Flange Bolts, Goose-neck Sets, Micrometer Grip Countersinks, Countersink Cutters, Hollow Mills, Bushing Indicators and Bushings.

**AERO TOOL CO.**  
CUPFORGED AVIATION TOOLS

ADD THIS COMPANY TO THE RED INDEX, AIRMAIL, OUTSIDE, CASE





## UP YOUR AIR TO UP PRODUCTION

There's a bigger job for compressed air in your plant today and tomorrow. Are you using compressed air power to the full? Do your present compressors have the capacity—the efficiency—that modern production demands? Here are two Gardner-Denver Compressors that can step up your air capacity at a lower cost per cubic foot of air delivered.



1—DESIGNED FOR DRUGGALLY LOW horsepower requirements—GARDNER-DENVER "85" SINGLE-STAGE HORIZONTAL AIR COMPRESSORS

- Long years of service assured by rugged, derivative construction.
- Extra efficiency due to liberal and unrestricted valve and port areas.
- "Air-Cooled" Dry-Plate valves actually become lighter with use.
- Built in capacities from 85 to 1292 cubic feet displacement per minute.



2—ENGINEERED FOR CONTINUOUS MAXIMUM PERFORMANCE—THE GARDNER-DENVER "94" TWO-STAGE HORIZONTAL AIR COMPRESSOR

- High overall efficiency assured by unrestricted air passages and large valve areas.
- A modern ramjet compressor assured by extra large water jacket areas.
- "Air-Cooled" Dry-Plate valves decrease noise and wear—actually eliminate valve breakage.
- Capacities range from 148 to 1824 cubic feet displacement per minute.

Write for complete information on the wide performance of Gardner-Denver "85" and "94" Horizontal Air Compressors. Gardner-Denver Company, Greeley, Illinois.

# GARDNER-DENVER

Since 1859



AVIATION April 1942



## REPLYING TO YOURS OF DECEMBER 7TH

America's answer to the call upon Pearl Harbor—A mighty armada of warplanes, many of the most deadly equipped with Bower Aircraft Roller Bearings.

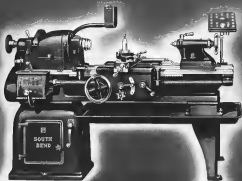


# BOWER

ROLLERS BEARING CO.  
CHICAGO, ILL.

# VERSATILITY

*to Speed Production*



**V**ERSATILITY which permits quick change-over from one job to another, with little inconvenience or loss of time, is a real speed-up factor in tooling a new job. Such versatility—the reduction of set-up time to a minimum—enables you to get into production quickly. It is one of the advantages in selecting South Bend Lathes for urgent defense contract work calling for early deliveries.

Precise accuracy is built into South Bend Lathes to assure uniform precision. Their wide range of

spindle speeds permits machining work with maximum cutting tool efficiency. And not the least important—their convenient controls make for an ease of operation which reduces fatigue and lessens the possibility of error.

Ideal for the heavy production schedules which National Defense demands, South Bend Lathes come in five sizes—9", 10", 13", 15½" and 36" swing—all sizes supplied with toolroom or manufacturing equipment. Write for catalog and name of nearest dealer.

## SOUTH BEND LATHE WORKS

755 East Madison Street, South Bend, Indiana, U. S. A.

LATHE BUILDERS FOR 35 YEARS



# ADEL

*Always Ahead  
THRU  
Design Simplicity*

Adel Precision Products Corp.,  
10777 Van Ouse St., Burbank, Cal-  
ifornia, Eastern Representative,  
J. Henry Kelson, Incorporated, Mary-  
land. Canadian Engineering Office,  
B. A. Thomas, Manager, 307 Bay  
Street, Toronto, Ontario



Adel Precision Products Corp. designs and manufactures a wide range of precision mechanical products and related manufacturing systems.

# Not to stop... but to DESTROY INVADERS



The U. S. Army Air Forces are not satisfied with using only the superior speed of fighter planes to intercept enemy bomber flights. The invader must be destroyed. A product of that belief is the Bell Aircraft, "Cannon on Wings." We are building the Mustang with a 57 mm. anti-tank cannon which fires explosive shells

through the nose. Amazing deadly accuracy, this feature is made possible by pushing the cannon forward in advance of the wings. 30 cal and 50 cal machine guns are also included to give the Mustang the greatest fire power among the world's single engine fighters. That is America's answer to Adolph Hitler



## BELL Aircraft CORPORATION

SUFFALO AND NIAGARA FALLS, N. Y., U. S. A.

*Making Aviation History*



**BUILD LIGHTER...  
ASSEMBLE *Faster*...**

**WITH THE *Fastest* THING IN FASTENINGS!**

You can always be sure of two fundamental facts about fastenings developed by TINNEMAN.

They are lighter in weight and are applied about twice as fast. In many aircraft attachments, they have saved as much as 80% in weight of fastenings. SPEED NUTS also affect drastic reductions in assembly costs and provide a double spring lock that resists the most severe vibration.

SPEED CLIP 5958 is our newest time saver for attaching junction box covers. It can be attached by hand and fits all junction boxes from .025 to .064 in metal thickness. Write for Bulletin 153 and we will rush complete information and samples.

**TINNEMAN PRODUCTS, INC.**  
2020 Fulton Road  
CINCINNATI, OHIO  
THE CANADIAN  
Walter Reed Co., Ltd., Hamilton, Ontario  
Dickens & Macmillan, Ltd., London

### NEW JUNCTION BOX FASTENING NO. 5958



Accelerates Assembly

*Speed Nut System*

Lowers Net Costs

OVER A BILLION IN USE • • OVER 1,000 SHAPES AND SIZES



SPARTAN  
NAVAL TRAINERS



# Powered by Lycoming

Naval cadets are earning their wings in Spartan trainers powered by Lycoming... the aircraft engine whose dependable, economical operation and low maintenance and upkeep costs have been proved through years of use in both the pilot training divisions of the Armed Forces and the CPTP

For literature or request for 50 or 100 h.p. - low  
monthly payment or 12.5 to 200 h.p. radial engines  
Write Dept. A-2. Specify which literature desired



Constructors in the U. S. Army and Navy

THE TRAINING PLANE  
ENGINE OF TODAY...  
THE PRIVATE PLANE  
ENGINE OF TOMORROW

LYCOMING DIVISION, THE AVIATION CORPORATION

WILKESBORO, PA.

AVIATION, April 1942

# Subcontracting

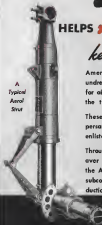
HELPS **AEROL STRUT** PRODUCTION

*keep ahead to keep 'em flying!*

America's aviation industry still must achieve an almost undreamed of pace of production. As builders of Aeral struts for aircraft landing gear, it is our grave responsibility to meet the tremendous demands of an all-out war without delay!

These demands will be met. But in addition to expanded personnel and plant facilities, another vital force has been enlisted to achieve this end—the subcontractor.

Throughout the nation, subcontractors are working to produce over 250 different parts for Aeral landing gear struts. This is the American way. Because of the willing assistance of these subcontractors, America can rest assured that Aeral strut production will keep ahead to keep 'em flying!



A  
Typical  
Aeral  
Strut

THE CLEVELAND PNEUMATIC TOOL CO.

Marble Ave. & East 77th St. • Aircraft Division • Cleveland, Ohio

CONTRACTORS TO THE UNITED STATES GOVERNMENT



## FORGET YOUR OLD ASSUMPTIONS

IMAGINEERING

IMAGINEERING

IMAGINEERING

IMAGINEERING



**IN THESE DAYS** an advertisement is no place either for homilies or sermons about production. Every man knows how well he is doing; the job that is before him. Deeds, not words are the measure.

**BUT WORDS CAN BECKON** beyond the realm of immediate duty.

**IMAGINEERING** is such a word. We coined it to make the needs of the future a reality, here and now. It is a way of describing what a man can do about the day when...

**HOW DO YOU DO IT?** You let your imagination soar and then engineer it down to earth. You think about the things you need to make, and decide that if you don't find out some way to make them immeasurably better you may never be asked by your customers to make them again.

**YOU FORGET YOUR OLD ASSUMPTIONS.** For instance, you may be one who used to assume that aluminum was too expensive. Even if you were right then (and you may not have been) the price trend of aluminum knocks those assumptions into a cocked hat.

**WERE YOU ONE** who used to assume that structures behaved exactly the way the theory said? Have you looked into the new screws the mammoth testing machine in the Aluminum Research Laboratory has found for that use?

**DID YOUR OLD PRODUCT GROW** like Topsy? More than one designer is Imagineering with this point of view: My product was in a groove. I couldn't get it out, because I didn't dare get too far away from last year's model. Now's my chance to start from scratch, and let tradition be hanged.

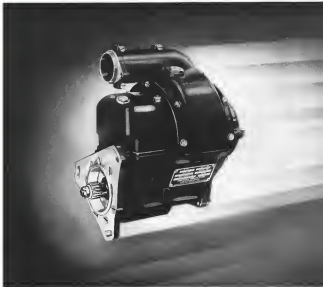
**WHAT IS THE KIND OF THINKING** that will make jobs in the future. It is the kind we can help with: help with ideas and with know-how. Will you write us?

Aluminum Company of America, 3181 Gulf Building, Pittsburgh, Pennsylvania.

## ALCOA ALUMINUM



SKY HIGH



For engines requiring magneto ignition, American Bosch has always been the hallmark of quality. The war in the air gives fresh significance to this reputation, for today American Bosch Aviation Magnetos are standard on some of America's mightiest warplanes.

AMERICAN BOSCH CORP., Springfield, Mass., and Providence, R. I. Branches: New York, Cleveland, Detroit, Chicago, San Francisco

# AMERICAN BOSCH MAGNETO



Official Photographer: U. S. Army Air Corps

★ **How PERMITE** ★  
helps ★  
**Save POUNDS**  
to add **MILES!** ★

**T**O help meet the vital need for eliminating useless weight in the construction of bombers, pursuit ships and other fighting equipment, Aluminum Industries plants are turning out PERMITE Aluminum and Magnesium Alloy Castings in innumerable volumes.

Just as the light weight and other special advantages of Permited Castings have long contributed to the efficiency of commercial and industrial equipment, so are they now contributing to the flying range and speed, and economy of our combat equipment.

Permited's pioneering experience, plus modern production and laboratory facilities, enable us to supply efficiently approved aluminum and magnesium alloys for aircraft parts, made to standards established by the Federal Specification Board, U. S. Army Air Corps and Navy Aircraft Department.

Defense manufacturers are invited to consult with our engineering staff regarding their casting requirements.

**ALUMINUM INDUSTRIES, Inc., Cincinnati, Ohio**

Branch: 910 New Center Bldg. — Los Angeles 124 N. San Pedro St. — Chicago: 616 So. Wabasha Ave.



**PERMITE ALUMINUM AND MAGNESIUM ALLOY CASTINGS**

AVIATION April, 1942



**NEW BENDIX UNIVERSAL  
PRESSURE REGULATOR  
(UNLOADING VALVE)**

*Superior performance results from  
new poppet-type pilot valve design*

Bendix Aviation, Ltd., presents this outstanding Hydraulic Pressure Regulator—with seven important advantages over all previous regulators—advantages achieved through the use of the exclusive plastic poppet pilot valve.

1. Absolutely leak proof. "Creep" toward the cut-in or cut-out pressures completely eliminated.
2. Guaranteed to operate at  $-55^{\circ}\text{F}$ .
3. No appreciable shift in operating pressures at a high system bleed-off or at various flow conditions.
4. No vapour system relief valve, eliminating extra cost and extra plumbing.
5. No lapped fits—faster production and easier maintenance as all parts are 100% interchangeable in the field.
6. Relief valve assembly is detachable from airplane without disturbing installation or plumbing.
7. One universal model for both 1,000 psi and 1,500 psi systems.



**North Hollywood**

SUBSIDIARY OF BENDIX AVIATION CORPORATION

- DISCONNECT COUPLINGS POWER BRAKE VALVES CHECK VALVES PRESSURE REGULATORS   
HAND PUMPS ACTUATING CYLINDERS HYDRAULIC ELECTRIC SWITCHES RESTRICTOR VALVES   
SEQUENCE VALVES HYDRAULIC SELECTOR VALVES TUBE CLAMPS CUSTOM BUILT RIGID

## WHERE WILL YOU SERVE?



If you are fitted and needed as a *native* or *valued*, enlist at once. But if you have a skill that makes you more valuable for technical service, then give it where it's needed. *If you do not have it, go out and get it.* Skills and accomplishments will do as much to win this war as machine guns and rifles, and you can play an important part by skillful handling of any of these.

## SPARTAN Training Will Equip You for An Important Position!

MORE than ever do we know that our greatest strength must be in the air. More than ever do we need skilled men and women to design, to build and to service our airplanes and our engines. We will fight this war in shops, in hangars and on the drafting board as well as on the battlefield.

SPARTAN School is one of the highest-ranking private aviation training institutions in the nation and is regarded with high favor by the U. S. Army and the commercial aviation industry. Out of SPARTAN's classrooms, shops and laboratories are coming scores of skilled aviation workers—mechanical engineers, aircraft and engine mechanics, aircraft assembly and installation mechanics, radio operators and maintenance men, pilots and flight instructors, instrument technicians, weather forecasters, sheet metal workers. These graduates are immediately stepping into important positions at good pay. In fact, SPARTAN is receiving calls for more graduates than can be supplied.

SPARTAN will train you so that you will be more valuable in serving your country...in whatever field of aviation you choose. Mail the coupon for sending giving complete information. Next semester starts May 25.



(Left) Drafting and Design Room at Spartan Day evening School



(Right) View in the Maintenance Engineering Building.

### SPARTAN'S New 6-Day-Week Schedule Shortens Training Period

Successful companies that trained men here supplied to all branches of aviation in the aviation field. Spartan now operates on 6-day week schedule and demands the personal attention to consider our courses approximately 25% shorter than the ones high quality training centers across the nation, based on proposed regulations for entry grade pay positions under. Mail coupon for complete facts.

## SPARTAN

SCHOOL OF AERONAUTICS  
DIVISION OF SPARTAN AIRCRAFT COMPANY

What About Your Future?—When peace comes, and it will come, aviation is going to be a greater industry than ever before. SPARTAN's superior training and unexcelled facilities can equip you for a prosperous lifetime career. Now is the time to act.



With Our Eyes  
to the FUTURE...

## We Give Our Complete Facilities to the Emergency of Today!

Devoted to duty's traditional with Spartan. For more than a decade this company has gained and maintained a reputation for doing one job and doing it well... producing the finest in aircraft.

Today... in defense of liberty... this tradition is being upheld and carried on in the manufacture of important aviation materials for the U. S. Government.

Tomorrow... after the battle is won... this same tradition of quality and dependability will be upheld and carried on in the new Spartan airplane of the future. Already Spartan is measuring the extent of its opportunity to be of national service after its defense responsibilities are discharged. Our eyes are turned to the future. We are planning ahead to the time when a new Spartan airplane of spectacular merit will be available for a peace-time, atomized America. Watch SPARTAN... a guide to first-ranking aircraft... yesterday, today and tomorrow!



Girls! Skilled women employees of the Spartan Aircraft Company are doing much to win this war. These employees are graduates of the Spartan School of Aeronautics. Courses: Women are now accepted in all courses at the Spartan School. Skilled women's graduates have no secondary course to complete.

THE SPARTAN SCHOOL OF AERONAUTICS, a division of the Spartan Aircraft Company, is also playing an important part in today's national emergency. From this school, recognized as the outstanding aviation school in the United States, some experts trained aircraft workers to efficiently serve the industry of every type of job. Thus does the Spartan factory have available an unlimited source of carefully trained and supervised employees.

## SPARTAN AIRCRAFT CO.

Center to the U. S. Army and the U. S. Navy  
TULSA, OKLAHOMA



### Building Fine Aircraft Since 1929

For many years the SPARTAN AIRCRAFT CO. has been known the world over as a leading supplier of aircraft service equipment. This efficient, low-cost, value plane consisted of an airplane under various corporate business and still more. Building planes was almost every day's work. Aircraft and equipment. This was built around... as we are planning ahead... is a new Spartan of more quality engineering and efficiency.

Spartan School of Aeronautics—Captain Maxwell W. Refner, Director  
Address Dept. A42, Tulsa, Oklahoma

Send me a 100 word Catalog describing in detail the SPARTAN course I have checked, and training facilities and living expenses.

Name \_\_\_\_\_ Age \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

Enclosure (if desired) \_\_\_\_\_

### CHECK COURSES YOU PREFER:

- |  |  |
|--|--|
| <input type="checkbox"/> Commercial Pilot                | <input type="checkbox"/> Aircraft Assembly Methods     |
| <input type="checkbox"/> Instrument Pilot                | <input type="checkbox"/> Design Service Methods        |
| <input type="checkbox"/> Extension of Flight Instruction | <input type="checkbox"/> Radio Mechanics and Operation |
| <input type="checkbox"/> Air Transport Day Training      | <input type="checkbox"/> Aircraft Fuel Systems         |
| <input type="checkbox"/> Instrument Engineering          | <input type="checkbox"/> Marine Engineering            |
| <input type="checkbox"/> Aircraft Engine Mechanics       | <input type="checkbox"/> Instrument Technician         |
| <input type="checkbox"/> Aircraft Fuel System            | <input type="checkbox"/> Marine Aircraft Technician    |

## Taft-Peirce Announces...



### THIS *NEW* BACK SPOT FACER

THIS MACHINE, already specified by leading aircraft motor manufacturers, was designed for counterboring or back-facing bores through which a hole has been drilled, but which, because of obstructions, cannot be counterbored or faced as a drill press, without complicated tooling.

The work is mounted on a 28" cross-hair cast-iron table, near the front of which is a hole which allows the shaft

of an inverted counterbore to project through the table. The unit containing the motor spindle, driven through bevel gears by a 1/2 h.p. motor, is located at the base.

The counterbored spindle is provided with fast and slow hand feeds. The machine is available with or without clutch for disengaging the power from the spindle. Write today for bulletin containing complete specifications.

**THE TAFT-PEIRCE MANUFACTURING CO.**

Worcester



Rhode Island



Where Inspection Ends . . .  
*Performance Begins*

• Piston Ring performance depends directly on design and then—faithful production.

Here at Muskegon the faithfulness of the finished product is made certain by rigid inspection of both materials and workmanship.

The most modern technical apparatus in the hands of experienced engineers assures Muskegon users of high and consistent performance.

Let us consult with you on problems relating to Piston Rings.

**MUSKEGON PISTON RING CO.**

Muskegon, Michigan

PLANTS AT MUSKEGON AND SPARTA



**MUSKEGON**  
*Piston Rings*





## New BALL-TYPE SWAGED FITTINGS

### FOR AMERICAN CABLE *Korodless* CONTROLS

When American Cable engineers originated *Performed Aircraft Cable and Strand* they made it possible for you to have controls with characteristics that are vital today.

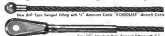
That is because American Cable's performing three wires and strands of internal stress. Therefore, cable and strand is easier to handle, quicker to install, and resists bending longer.

The same organization originated swaged fittings to reduce weight, save cable, and give you fittings that hold beyond the rated strength of cable or strand with which they are used.

They developed efficient rings, anchor ropes and mooring pendents. They organized to supply complete assemblies to your specifications—meeting Army and Navy requirements.

Now they offer you another great advance—American Cable control assemblies that use the new **TRU-LOC BALL-TYPE SWAGED FITTINGS**.

These new fittings also hold beyond the rated strength of strand or cable. Yet they are only a fraction of the size and weight of other fittings of equal strength—in line with modern design and a tremendous advantage for work in close quarters.



View Full-Type Swaged Fitting with 1/2" American Cable "KORODLESS" Aircraft Cable

View "C" Swaged Type Swaged Fitting with 1/2" American Cable "KORODLESS" Aircraft Cable



To save the weight for the new design, the TRU-LOC BALL-TYPE SWAGED FITTING FOR AIRLINE CONTROLS.

AMERICAN CABLE DIVISION • WILKES-BARRE, PENNSYLVANIA

Aircraft Supermarket—230 Park Avenue, New York

4-232 General Motors Building, Detroit 3473 Porter Street, Los Angeles

AMERICAN CHAIN & CABLE COMPANY, Inc.

BRIDGEPORT • CONNECTICUT



## ARTILLERY of the Air



### Cannon Nosed 'Cobras Take the Offensive Aloft

The artillery officer's dream of a flying gun-platform finds practical expression in the high-performance Bell Airacobra. With specially designed Curtiss Electric Hollow Hub Propeller accommodating a 20 or 37 mm. cannon, the Airacobra can strike the enemy on the ground or in the air with lightning speed and effect.

CURTIS-WHEAT CORPORATION • PROPPELLER DIVISION • CLEVELAND, OHIO

CURTIS *Electric*  
PROPELLERS



## Answers to 17 questions most frequently asked about FLUORESCENT LIGHTING EQUIPMENT

Never before have we been asked so many questions by Production Men, and these these facts would seem to explain their growing interest in fluorescent lighting equipment.

1. The many advantages of fluorescent lighting equipment in general.
2. The greater cost of fluorescent over incandescent equipment, making light today a major production.
3. The current importance of higher illumination in the war effort.

It seems timely, therefore, to answer the most frequent questions in this REPORT TO PRODUCTION-MEN.

Is there any one best kind of industrial lighting? Yes, undoubtedly. Fluorescent lighting is preferred "the new standard for industry" by lighting authorities.

Is there any one best fluorescent-lighting system? The Miller MILLER 50 FOOT CANDLE, the MILLER MILLER 100 FOOT CANDLE, the MILLER MILLER 100 FOOT CANDLE, and MILLER THROFFERS are naturally superior to any other equipment on the market today. The MILLER System was the original mechanism for lighting systems.

When were the first MILLER installations made? MILLER fluorescent lighting has been in use since January, 1942.

How many installations have been made? Over 100 million of MILLER fluorescent lighting systems are in use.

What kind of plants use fluorescent lighting? In all types of plants, from small, one-man shops to large, multi-story buildings, fluorescent lighting is used.

What kind of industries use fluorescent lighting? In all types of industries, from small, one-man shops to large, multi-story buildings, fluorescent lighting is used.

What about production for the war? Fluorescent lighting is used in all types of plants, from small, one-man shops to large, multi-story buildings, fluorescent lighting is used.

are supplying 100 percent with the war effort.

Are you proud to have a fluorescent lighting system? Yes, MILLER offers a complete line of fluorescent and incandescent lighting equipment for every commercial and industrial need.

What is the significance of the name 50 FOOT CANDLE and 100 FOOT CANDLE? The 50 FOOT CANDLE, using 40-watt Mazda F lamps, is designed to provide a minimum of 10 foot candles of illumination, and the 100 FOOT CANDLE, using 100-watt Mazda F lamps, a minimum of 100 foot candles when installed and spaced as shown, providing in the average plant.

Are MILLER lighting systems better than those of other manufacturers? Yes, MILLER lighting systems are better than those of other manufacturers because they are more than a "fixture" but they provide a complete lighting system, including electrical, wiring and materials, making possible savings of 25 to 30 percent in the cost of installation.

Are 50 FOOT CANDLE and 100 FOOT CANDLE suitable for lighting offices, drafting rooms, and similar locations? They are, and MILLER THROFFERS, Commercial fluorescent lighting systems, are recommended for use with incandescent lighting systems. You can have 100 foot candles of MILLER THROFFERS in any room.

Any "bug" to be eliminated from this lighting equipment? No. You carry MILLER's products, and know best.

How many times have you seen a fluorescent lighting system in a manufacturing or war plant of all kinds?

What do you mean "fluorescent"? Each fixture (excepting effect of some lighting systems) carries a white, granular material by The Miller Company's 10 years of specialization in lighting equipment.

Have you ever seen a fluorescent lighting system in a manufacturing or war plant of all kinds?

What about production? Simple in the extreme. The production of fluorescent lighting is easy to install and data.

What of the benefit? Should you have to manufacture or do anything different work in your plant, you can do so with the MILLER lighting system, should you want greater illumination, you can put up to 40% more without adding new fixtures.

How do you get about getting out plant? Should you have to manufacture or do anything different work in your plant, you can do so with the MILLER lighting system, should you want greater illumination, you can put up to 40% more without adding new fixtures.

How do you get about getting out plant? Should you have to manufacture or do anything different work in your plant, you can do so with the MILLER lighting system, should you want greater illumination, you can put up to 40% more without adding new fixtures.

How do you get about getting out plant? Should you have to manufacture or do anything different work in your plant, you can do so with the MILLER lighting system, should you want greater illumination, you can put up to 40% more without adding new fixtures.

How do you get about getting out plant? Should you have to manufacture or do anything different work in your plant, you can do so with the MILLER lighting system, should you want greater illumination, you can put up to 40% more without adding new fixtures.

How do you get about getting out plant? Should you have to manufacture or do anything different work in your plant, you can do so with the MILLER lighting system, should you want greater illumination, you can put up to 40% more without adding new fixtures.

How do you get about getting out plant? Should you have to manufacture or do anything different work in your plant, you can do so with the MILLER lighting system, should you want greater illumination, you can put up to 40% more without adding new fixtures.

How do you get about getting out plant? Should you have to manufacture or do anything different work in your plant, you can do so with the MILLER lighting system, should you want greater illumination, you can put up to 40% more without adding new fixtures.

How do you get about getting out plant? Should you have to manufacture or do anything different work in your plant, you can do so with the MILLER lighting system, should you want greater illumination, you can put up to 40% more without adding new fixtures.

How do you get about getting out plant? Should you have to manufacture or do anything different work in your plant, you can do so with the MILLER lighting system, should you want greater illumination, you can put up to 40% more without adding new fixtures.

How do you get about getting out plant? Should you have to manufacture or do anything different work in your plant, you can do so with the MILLER lighting system, should you want greater illumination, you can put up to 40% more without adding new fixtures.

How do you get about getting out plant? Should you have to manufacture or do anything different work in your plant, you can do so with the MILLER lighting system, should you want greater illumination, you can put up to 40% more without adding new fixtures.

IF YOUR ENGINE SHOWS THIS...JUST PULL A HANDLE...



YOU see that your engine's on fire. You reach for a handle. Give it a pull. A rush of LUX carbon dioxide snow and gas smother the flames. Nothing could be simpler! It's quick too! No extraordinary agent in operation while the faster than LUX carbon dioxide LUX checks out fire in 3 to 4 seconds!

And it's clean too! No fire killer is so completely harmless to engines, accessories. Clean and dry, LUX gas disappears into the air when the extinguishing job is done. There are no LUX Systems for both multi-engine and single-engine planes... for "inline" as well as radial engines LUX flame

detectors, loaded with built-in LUX Systems, may be used on the acting element of a completely automatic fire lighting unit. Why choose fire in the air, as on the ground, when protection against it is so easy, sure? Write us for the free booklet—"White Magic"

Walter Kidde & Company, Inc., 422 West St., Bloomfield, N. J.

AVIATION, April, 1942

27

**MILLER**

**50 FOOT CANDLE  
100 FOOT CANDLE  
MILLER THROFFERS**

Commercial Warrenton Fluorescent  
Lighting System

**THE MILLER COMPANY**  
MILFORD, CONN.

Factory at Groton, Conn. Since 1914

A MILLER offers a complete line of  
incandescent and fluorescent lighting equipment

# ADVANCED TRAINERS

*Powered by.*



Circle 117

**JACOBS**  
*Engines*

ARE TRAINING THE COMBAT PILOTS  
FOR THE UNITED NATIONS



**JACOBS AIRCRAFT ENGINE CO.**

POTTSTOWN, PENNSYLVANIA, U.S.A. . . . CABLES: JAECO

## THE RED CROSS

needs the financial aid of every American.



Contribute today through your Local Chapter.

Be as generous as your circumstances permit.

THIS SPACE CONTRIBUTED BY THE B & G CORPORATION



# FEDERAL

## Aircraft BEARINGS



FEDERAL SPECIALIZES IN THE PRODUCTION OF QUALITY BALL BEARINGS • ITS POLICY IS TO MAKE THE FINEST BALL BEARINGS REGARDLESS OF ANY OTHER CONSIDERATION • THE FEDERAL ORGANIZATION IS DEDICATED TO THIS ONE PURPOSE—THIS ONE IDEAL •

THE FEDERAL BEARINGS CO., INC.  
*Makers of Fine Ball Bearings*  
Piquetteville, N. Y.

Branch Office: 2615 East 17th Ave. • Cleveland Office: 400 Euclid Building  
Chicago Office: 302 S. Wabash Ave. • Los Angeles Office: 6015 Wilshire Blvd.



# Need 'em?

# You bet you do!

And they are in mass production... every required relay, contactor and circuit breaker built to specifications by men who know aircraft needs from ground to ceiling.

What about your requirements for electrical contactors, relays and circuit breakers? In the Cutler-Hammer line you will find the electrical equipment you need, the most modern accepted and service-proven designs, built to specifications, accepted by both army and navy, and already in mass production. No delay for development work. That's been done... by CH engineers long familiar with aviation needs and known the world over for their leadership in electrical control equipment. Samples can be sent you immediately. Write or wire today. CUTLER-HAMMER, Inc., 1413 St. Paul Avenue, Milwaukee, Wisconsin. Associate: Canadian Cutler-Hammer, Ltd., Toronto.

1840-1940

50th ANNIVERSARY

*Features that count*  
These aren't adaptations. These are specific designs for exact airplane operating conditions.

Transmitters receive emergency push or stop circuit current. Capable of handling emergency push or stop circuit current. Will operate in any position. No moving contact. Tested for operation at maximum flight altitude. Minimum hammer blow operation. Reverse polarity operation under all conditions. Calls for trouble. C-H Vacuum for propellers optional feature.

✓ Cutler-Hammer makes a complete line of:

✓ Contactors for remote control of:  
Battery disconnect, Wing flap motor, Fuel pump motor, Landing lights, Aileron control motor, Hydraulic pump motor, Servo valve, Motor control motor, Fuel pump motor, Gun flap motor, Motor control motor, Motor, Landing gear motor, Gun flap motor, Motor, Landing gear motor.

✓ Relays for gun firing, Interlocking control circuit, Motor.

✓ Circuit breakers and switches for all purposes.

Not just one or two items or types but a complete line from 25 to 200 amps, single pole, single throw, single pole, double throw, double pole, single throw, double pole, double throw.



## CAN AMERICA BUILD 185,000 Planes IN TWO YEARS?

The President has called for 60,000 planes that year—125,000 next year—a total of 185,000 planes within two years. That's a lot of airplanes—and they'll take a lot of aircraft tubing—but the planes will be built. Americans won't let America down.

And we at Steel and Tube Electric are working to help out effort to supply more and more Republic ELECTRUNITE Aircraft Tubing to the Aviation Industry. ELECTRUNITE—made by the same proved process of electric resistance welding used in producing millions of feet of pipe, mechanical and structural tubing—meets specification standards of the U. S. Army Air Corps, Bureau of Aeronautics, U. S. Navy Department and the Civil Aeronautics Administration.

Every length is consistently uniform in diameter, wall thickness, concentricity, strength, weight, ductility, hardness, weldability and scale-free surface.

Every length undergoes a special non-destructive electric test to assure absolute freedom from any possible hidden defects.

Republic ELECTRUNITE Aircraft Tubing is made in sizes from 1/2" O.D. up to and including 1 1/2" O.D.—and in gauges from .030" up to and including .045"—in S.A.E. 31-6130 steel.

Republic ELECTRUNITE Tubing also is made of ENDURO® Stainless Steel in standard analyses and in sizes from 1/2" O.D. to 3" O.D.—in gauges from .025" to 11 gauges—and in conformance with Government Specifications.

For complete detailed information write—

**STEEL AND TUBE DIVISION**  
REPUBLIC STEEL CORPORATION  
CLEVELAND 1, OHIO

Region: Manufacturing Division • Sales: Steel Products Division  
Cities: Denver and Chicago • District Offices • Trunk Line Connections

Circle 10 on Reader Service



# Republic

## ELECTRUNITE

ELECTRIC RESISTANCE WELDED TUBING

Also Boiler Tubes • • • Condenser and Heat Exchanger Tubes

## THIS BAKER TRUCK broke records in 1923!

### Still going strong in 1942!!



Nineteen years ago Baker solved a vital handling problem for the steel industry, when it introduced the new truck. The second steel truck ever built was purchased by a large steel producer at Warren, Ohio. In going through some old files, we came across the letter at the right, showing how that truck was received. Immediate savings of 35 men hours per car loading were gained.

Since 1923 the identity of this mill has been lost in a merger. The Steel Industry has expanded to gigantic proportions. New trucks have been accepted as standard equipment for handling coils. Yet this pioneer Baker Iron Truck, having handled millions of tons of steel, is still on the job—still turning in an full quota of work, day in and day out.

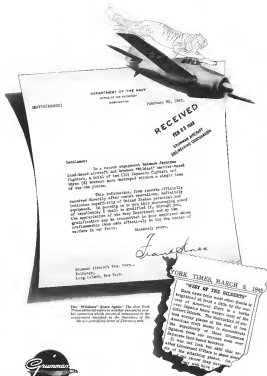
Long life in an industrial truck depends on advance

design as well as on steady construction. Baker Trucks are designed to defy obsolescence, and are made to take plenty of abuse without showing their age. Let us demonstrate how they can serve you in your plant.

**BAKER INDUSTRIAL TRUCK DIVISION** of The Baker Iron Works Company  
2112 WEST 25th STREET • • • • • CLEVELAND, OHIO



AVIATION, April, 1942



SNAPHAN AIRCRAFT ENGINEERING CORPORATION • SEAFORD • LONG ISLAND • NEW YORK

AVIATION, April, 1942



"The Way of The Great Silver Fleet"  
is the way of good maintenance, with

"We send them on their way, serviced with Snap-on!" says Mr. H. G. Ledy, Maintenance Superintendent of Eastern Air Lines. "As our airports and overhaul shops, the dependability and flexibility of Snap-on tools are important factors in providing over-light standards of maintenance."

And that's another of America's famed Air Lines test-flies to the high quality of Snap-on tools . . . to performance as depend-



able in critical as in the automobile and industrial fields where "Snap-on" has been a name for tool leadership for 22 years.

Snap-on's 3,000 tools and direct-to-you service are conveniently near you from 35 branch houses in key aviation centers throughout the United States and Canada. Write for catalog and full information.

OVER 3000  
HAND AND POWER  
TOOLS—FROM  
NUTS AND BOLTS  
TO HEAVY DUTY  
UNITS



SNAP-ON TOOLS CORPORATION, 2020-D 221st Avenue, Kenosha, Wisconsin

AVIATION, April, 1942

# DEFENDERS OF LIFE, LIBERTY, AND THE PURSUIT OF HAPPINESS

*Printed as by the Constitution of the United States, in our heritage of freedom, but foremost among the guardians who secure this glorious privilege is the gallant host who wears the insignia of our Air Force... Physically the most of our mankind—richly the best of all time, but no matter what their courage or daring, men of the Air Force must have first-class equipment—planes, parts, machines—and have them delivered in their needs! It is a significant tribute to America's skill and ingenuity that we are now going "all out" producing the several winning commissions awarded us for use of the Armed Forces. • • • • • The Air Force Defender, designed by customers as "brave of the post" is similar to the motor ship, the G M, now "on operation" with the Army Air Corps. • • • • • Air Force Defender Corporation, Middleburg, Ohio, U. S. A.*



## The Air Force Victory Award

*The Air Force Defender Corporation pledges its entire resources of experience and energy, not to produce only the finest in material and machine work (for the man who sets the pace in his own country) • • • • • The "Air Force Victory Award" presented to employees for skill that develops better products in greater increasing quantities is our dedication of an "all out" effort to win the war in the shortest space of time.*



# ERONCA



## Where the job is important —files must be right



Two mechanics working up an oil line before attaching it to the first being inspected during aircraft job. Courtesy United Air Lines.



To carry assurance of Victory, America's war effort must be efficient as well as big. In airplane construction and maintenance especially, not a single detail must be left to chance or to execution that is just "good enough." Only "the best job that can be done" gets the highest inspector's stamp.

Each high standard of workmanship demands the right tool, as well as the right man, for the job. In a file it means one that is worked in design and size for the kind of metal, shape or part in which it is used, for the amount of metal to be removed and the finish or precision to be obtained.

In addition, it must be thoroughly dependable—of uniformly fine steel, uniform cut, uniform hardness—so that the handwork it will render exactly the same performance on the first.

There is no better manufacturing guide than the recommendations of the largest manufacturer of quality files in the world—under the Nicholson guarantee of Twelve perfect files in every dozen.

These Nicholson special purpose files commonly used in aircraft work are shown and briefly described at the right. TECHNICAL BULLETINS on these, and also on files for Foundry Castings, Die Castings, Lathes, Planes, and for Drilling, Boring, Taps and Reamers, will gladly be mailed on request. Name ours desired. For your file needs, instant your mail supply house.

NICHOLSON FILE CO. • PROVIDENCE, R. I., U. S. A.  
(Also Complete First-File Plans, Old.)

## NICHOLSON FILES

FOR EVERY PURPOSE



### ALUMINUM TYPE "B" FILE

For special aircraft work and even General use—no previous filing and "Machine" File. The rapid filing of aluminum and other ductile metal castings, bars and sheets in flat and ball round shapes, not full range of sizes.

### BRASS FILE

For use in a short space of time, the best of the Nicholson Brass File are made with a rear bevel and fine cross-hatch. The precision used and long service life is the chief of them. Also general "general."

### STABILIZED STEEL FILE

To remove the abrasive action of the steel's hard chromium carbide and nitride alloy, the Nicholson Stabilized Steel File are made with 100% oil soluble steel of very close file. It makes the work smooth in their action work smooth filing in this action.

**UNITED AIR LINES**  
COAST-TO-COAST

**1941 SAFETY HONORS**  
GO TO  
**DOUGLAS EQUIPPED AIRLINES**

**BRANIFF AIRWAYS**  
GREAT LAKES TO THE GULF

Ten of the airlines cited by the National Safety Council for operating without a fatality throughout 1941 were Douglas equipped. Top honors went to United Air Lines and Braniff Airways.

Thus in war as in peace the nation can "depend on DOUGLAS."

**DOUGLAS AGAIN *first* IN AIRLINE SAFETY**

Following are the Douglas-equipped airlines of the Americas: American Airlines Inc., Braniff Airways Inc., Canadian National Airways Inc., Canadian Air Transport, Chicago & Southern Air Lines Inc., Delta Air Corp., Eastern Air Lines Inc., Hawaiian Airlines, Ltd. (Great Island Airways Ltd.), Northwest Airlines Inc., Northeast Airlines Inc., Pan American Airways System, Pan American Overseas Airways, Pan American Central Airlines Corp., T.W.A., Inc., Western Air Lines Inc.

AVIATION, April, 1942

## Latest Data on Electrical Contacts... Materials, Design, Production...

***Yours for the Asking!***



Electrical contacts coated the carpeting of the nation's highways... on land, in the air, and in the sea. Mallory has been the nation's headquarters for contacts and contact assemblies for more than 20 years... while Mallory engineers have developed improved contact materials, new contact designs and high-speed production techniques for turning out better electrical contact faster, at low cost.

The new Mallory Contact Catalog offers you more than 50 pages of useful data... a factual digest of more than 20 years of electrical and metallurgical research. Here are a few features of this informative, illustrated book:

1. How To Select Contacts—electrical, mechanical and economic factors.
2. How To Design Contacts—both standard and special types.

3. Mallory Contact Materials—chemical and physical properties and typical applications of tungsten, molybdenum, fine and coarse silver alloy, alloy of silver, platinum, palladium and gold (Elconite Series), powdered metal alloys, copper, silver and other metals (Elastimate Series), Mallory Inlay and Overlay Metals, and Mallory S.C.C. Metal.

4. Availability Table for Contact Materials.
5. Mallory Individually Fixed Type Contacts—a new development.
6. Mallory Complete Contact Assemblies—to speed your production.
7. Mallory Allows for Current-Carrying Springs.
8. How Mallory Develops and Produces Contacts.
9. Contact Application Index—to make it easy for you to refer to products you manufacture or consider manufacturing.

Write us today on your company's stationery for your copy of this new complete Mallory Contact Catalog.

• P. E. MALLORY & CO., INC., INDIANAPOLIS, INDIANA • Cable Address—PEMAL20 •

**P. E. MALLORY & CO. INC.**  
**MALLORY**

**ELECTRICAL CONTACTS AND CONTACT ASSEMBLIES**  
**NON FERROUS ALLOYS, POWDERED METAL ALLOYS**

AVIATION, April, 1942

The field for the application of strain measurements is so broad and the variety of types and auxiliary equipment available so great that the selection of the proper instrument for the specific job is often confusing. Care is essential in making this selection for satisfactory results. Of the many types of gages and auxiliary equipment available, a few are shown below.



#### ELECTRIC STRAIN GAGES

Here are three types of electric gages that are widely used to measure strain in bridges, bridges, buildings, dams, towers and other engineering structures. Also shown: "Electric" 10-1 Model, McPherson Electric Company, Inc., New York.



#### WHEATSTONE BRIDGE CONTROL BOX

A secondary and exceedingly accurate instrument for the measurement of strain or slowly applied stress.



#### AMPLIFIER AND OSCILLOGRAPH

These shown above are used for accurate, sensitive measurements in "testing" or applying the subject of stress gages. The nature of the stress and type of gage govern the choice of amplifier. An oscillograph or recorder is necessary to obtain permanent records of strain. The Crystal Gage and an Oscillograph shown above are in use at several universities in the U.S.

Illustration: William G. Gage, Inc., New York.

Other testing equipment in the strain measuring group. Waugh Laboratories, Inc. is present quick testing of stress gages. Electronic Oscilloscope and recorder for measuring strain. Oscilloscope for measuring displacement. Resonant Mechanical Oscilloscope for applying stress tests.



### His eye can see the strain in a girder's heart

The engineer who is properly equipped can determine the existing stress in any member of any structure. His gage can weigh less than 2 ounces... yet it can "look" inside the heart of bridge girders, steel rail, concrete base, or factory floor—and record graphically what it "sees."

WAUGH LABORATORIES makes available a complete line of test instruments and machines, together with an engineering field service and laboratory facilities, for analyzing strain forces and vibrations in and on structures.

For information regarding its service applications in particular industries, write to Vernon H. Roe, Director, at the address below.

**WAUGH Laboratories**



A DIVISION OF WAUGH EQUIPMENT COMPANY • 430 LEXINGTON AVENUE, NEW YORK, N. Y.  
Pacific Coast Branch: Pasadena Securities Bldg., Los Angeles, California

## No more "stock-outs"



with fabricated parts of Westinghouse Micarta

Even the best priorities can't assure immediate deliveries on metals. But Westinghouse Aircraft Micarta in standard structural shapes is an available, easily standard, light, strong, lightweight—yet many customers superior, for aircraft use, to the critical material it replaces.

Many aircraft parts now made of metal can be fabricated from one of our grades of Micarta:

**GRADE 202** (upper half) is best in wet and is recommended for single use with medium-heavy stresses.

**GRADE 204** (upper half) has superior resistance to moisture and has high dielectric strength.

**GRADE 206** (lower half) has high mechanical strength, excellent machining properties, good electrical strength.

**GRADE 208** (lower half) has very high impact and mechanical strength. This grade is widely used for general purpose aircraft applications.

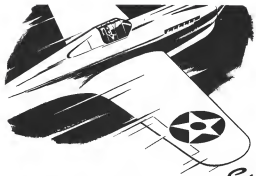
In addition to standard plate, Westinghouse Aircraft Micarta is supplied in angles, channels, rods, and bent-up tubes. Full engineering data on Aircraft grades of Micarta, and how they compare in physical properties with metals and woods commonly used in aircraft manufacture, is contained in a new Engineer's Handbook just published. If you have not received a copy, write for one on your company letterhead—today. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-34. 24000



**Westinghouse**

AIRCRAFT MICARTA





We've hitched our production to a *Star*

• American airmen need armorment—all we can give them! And Van Dorn is seeing that they get tons of it—armor plate that makes the cockpit of an American plane the safest place in the air during combat.

We volunteered for war work back in 1939. With our 64-year reputation as master metal fabricators—our large corps of specialists in welding, heat treating and

machining—our service stripes in war production won in 1914-1918—and our great metal-working equipment, we "passed muster" with flying colors.

Now, a two-year veteran in modern war output, Van Dorn is a full-time producer of armor plate—making our airmen the safest in the world—protecting our tank and gun crews in the Battle for Victory.

**THE VAN DORN**  
**IRON WORKS COMPANY**

2402 EAST 77TH STREET • CLEVELAND, OHIO

DESIGNERS AND BUILDERS OF PRISON EQUIPMENT SINCE 1878

AVIATION, April 1942

Butter Enemy Ships  
JYRESS SINAS JAP SWY  
Flying Fortress  
Squadron Cracks  
Enemy Warships  
FORTRESSES

BOEING BOMBERS IN ACTION  
BLAST NAZI BATTLESHIP

BOEING BOMBERS GET 1 MORE SHIP  
4 FLYING FORTRESSES  
DOWN 9 JAP PLANES!

Flying Fortresses' Lead

**More are coming!**

To join the Flying Fortresses already in action on world-wide fronts, large numbers of these long-range, four-engine Boeing bombers are now rolling off American production lines.

\*replaced Boeing trademark

**Boeing**  
AIRPLANE COMPANY

UNITED STATES FLYING FORTRESS AIRCRAFT IS BEING JAPANESE



THIS IS HOW BOEING WORKERS ARE ANSWERING THE CALL



MAKING COMPLETELY NEW FORTRESSES COME FROM THE FLYING



PROGRESS BOMBSIGHTING MOVES FORWARD IN LONG LINES



U.S. FORTRESS  
PILOTS BLAST  
NIPPON CRAFT  
IN EAST ASIAN  
Flying Fortresses Get  
6 of 30 Jap Fighters  
Boeing Bo  
Join in F  
Down F  
Plane  
FLYING FORTRESSES WRECK  
HUGE JAP LANDING PART  
FLYING FORTRESSES TAKE BIG  
ENEMY FIGHTER PLANE TOLL  
BOEINGS BOMB JAP SHIPS  
FORTRESSES BOMB FOE  
Allied Aircraft Bom  
New

# DoAll works for Howard



• At the Howard Aircraft plant, the efficient DoAll is doing a very patriotic job on all kinds of plane parts—speeding up production of their new 5-place Liaison Transports for the Navy. The mechanic in the picture is sawing out a dual wing fitting.

DoAll is the fastest precision method of removing metal—saws, files and polishes any kind of metal or alloy used in planes, including aluminum, stainless steel, copper, magnesium, synthane, pyralite, etc. Among the 42 DoAll saw bands, 23 file bands and 3 polishing bands, there is a "best" one for each job.

## and ... DoAll Can Work for You

Whether you make or assemble planes or parts, you will find the DoAll a real money maker. It comes to cutting tubing, saving out 40 to 60 parts at one time from stacked sheets or making special tools and parts (without dies) from block or bar metal in one-half to one-quarter the usual time.

Today DoAll is one of the greatest factors in winning our race against TIME in tool rooms, repair departments and in regular production work.

You'll be amazed at the many ways in which a DoAll can save time and money in your plant. Ask to have a DoAll expert call and demonstrate its versatility.



IN  
U. S.  
FIELD  
SERVICE



One of the best of portable machine tools of the U. S. Air Corps for making special planes in the field. Over 100,000 copies can be constructed and repaired right on the spot. Each unit measures a DoAll One ton machine or part of its equipment.

NEW—interesting and valuable book "DoAll on Production". Send for copy.



**CONTINENTAL MACHINES, INC.**  
1305 SOUTH WASHINGTON AVE. • MINNEAPOLIS, MINNESOTA

Associated with the DoAll Company, Inc. Chicago, Illinois.  
Manufacturers of Band Saws and Band Blasts for DoAll Center Machines



**WORK NOW TO RULE THE BLUE IN '42**

A SLOGAN FOR AMERICANS

SUGGESTED BY R. D. DEWESE  
HOWARD AIRCRAFT CORP., CHICAGO, ILL., U. S. A.



To high school grads  
and college men  
between 18 and 21 years of age—  
NOW is the time to

## Get Your GROUND WORK in Aviation



Final check and inspection of built engines also has been included



Student and instructor discuss construction of heavy airplane pilot



A scene of Boeing School's Personnel and Overhaul Shop

If you want to prepare yourself for the best service to your country and the aviation industry, consider seriously what Boeing School of Aeronautics offers you now.

To young men who have aptitude and adequate training in mathematics—

*Nine months' work at Boeing School will prepare you for the U. S. Government aircraft mechanic rating or aircraft engine mechanic rating. One year will prepare you for both these basic ratings. Eighteen months will enable you to complete a course in Airline Operations and Engineering that includes preparation for the mechanic ratings and for a ground class commercial radio-telephone operator's license.*

The Air Corps and the Airlines need men who have had this training.

Boeing School courses are open to men older than 21 depending on their Selective Service status.

Make up your mind now to enroll for training at Boeing School of Aeronautics. The reputation of Boeing School, the thoroughness of its instruction and training, justifies the statement—*Getting Ground Work Good.*



*Now!*

A VARD SNAP GAGE

We have just introduced a new precision checking tool in the VARD Roll Thread Snap Gage. This VARD gage offers definite improvements over existing gages. It not only checks the pitch and depth of the thread to be inspected but also checks the lead. Furthermore the new VARD snap gage will check threads right up flush against a working shoulder.

This is a beautifully made production inspection tool with Go and No Go thread rolls. Its rolls are ground from special tool steels and are fitted with eccentric pins to compensate for wear. The gage fits the hand and is easy to use.

VARD Roll Thread Snap Gages are made in a full range of sizes in tolerances from 0 to several thousandths. They can be sold to holders of high performance ratings.

### Mail this coupon today.

You will receive complete information regarding the many career courses, faculty, and equipment of Boeing School of Aeronautics. The next classes start May 25, August 3, October 12, and January 6, 1943.

Boeing School of Aeronautics  
3801, Boeing Way S.  
Auburn, Wash. 98002

Copy to me: ☐ Please forward without cost to me—the Boeing School of Aeronautics supplying information regarding the school and describing in detail the courses checked below.

Name \_\_\_\_\_

Street address \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_

Age \_\_\_\_\_ Previous schooling \_\_\_\_\_

☐ Airline Mechanic  
Airline Technician

☐ Airline Mechanic  
☐ Airline Overhaul

☐ Airline Operations and Engineering  
☐ Commercial Engineering



**BOEING SCHOOL OF AERONAUTICS**



A DIVISION OF  
**UNITED AIR LINES**

**VARD INC.** PASADENA, CALIFORNIA  
SUCCESSOR TO VARD MECHANICAL LABORATORY

**The Machine  
... the Part ...  
and the Product**



**TYPE  
TEST:**

**Full-load, full-speed landing impacts**

... 200 of them



**BENDIX PRODUCTS  
DIVISION  
OF BENDIS AVIATION  
CORPORATION**

Scores of precise inspections during and after manufacture of Bendix Pneumatic Shock Struts maintain the close dimensional tolerances and high metallurgical standards demanded by the service these members must render.

Distinct from all such precautions is this additional Type Ten illustrated, to which every finished strut is subjected. A massive punch press adaptation "pumps" the strut through in full range for 200 strokes. After this ordeal, the strut is held in the static load position for 20 minutes to check for possible leakage of hydraulic fluid.

"Happy Landings" are the result of this kind of carelessness—characteristic of America's Air Services.

**Bendix** **LANDING-GEAR EQUIPMENT**

AIRPLANE WHEELS AND BRAKES • PNEUMATIC SHOCK STRUTS  
SWIVELABLE AND STEERABLE TAIL-KNUCKLES • PILOT SEATS

**Money, Materials and Profits**

WHEN CITIZEN JONES relaxes in his comfortable chair at night and reads that 60 billion dollars more have been appropriated by Congress for planes and guns and tanks, he slips the unpleasant report of the latest enemy victory and retains confidence that the war is in our bag. He also skips the news item based on page 24 that President Tojo has just told his subjects that "War is not won with money." But this happens to be an instance in which Tojo's bloody doctrine is quite right. There is far too much talk about money winning wars Washington these days and it is building up a false sense of security among American people. Neither money nor strategy will help us win this war.

When the final score is chalked up it will be a problem in simple addition. The side having employed the greatest amount of efficiently and man-hours of labor and the largest percentage of materials will be the winner. At the moment we are short on both of these but the most serious shortage is in materials.

The conversion of workers from other industries into even from agricultural pursuits to aircraft orders has been slow and is being done with greater ease than was thought possible. The industry has recruited vast armies of workers and placed them along many newly-created production lines. But all of this is of no avail if these workers are required to make bricks without straw.

Aircraft production has been aptly defined by one authority as "the accumulation of shortages." As production lines crisscross, the whole manufacturing mechanism rapidly becomes more delicate. Failure of an insignificant sub-component to deliver on schedule, interruption in the just-in-time delivery of any single part or material, one play house with foul weather and upset the efforts of tens of thousands of workers.

After a production line has been set up it is a comparatively simple matter to keep it going, as long as the manufacturer is given what he needs when he needs it. We can reach the high objectives in aircraft production set by the President only if the materials are forthcoming on schedule.

Further evidence of the unimportance of money in the present war effort is found in the financial reports of several aircraft manufacturers, which are scattered elsewhere in this issue. Several of these manufacturers have gone in for a new kind of financing which should set an enviable example for other industrialists. They have performed another almost unprecedented feat in voluntarily returning funds to the government. United Aircraft has passed 1941 operating expenses back to the Navy Department to the tune of \$10,000,000. North American has cut losses on suspended contracts. Douglas has cut fees on suspended contracts to 3 percent below costs, and has reported a net profit on Army-Navy orders of 1.3 percent in 1941.

A number of serious considerations are arising aside from the reports of these admirable transactions from war to peacetime operations. It is only reasonable to assume that the cost of readjustment after the war will be considerable to the extent change-over from a peacetime to a war basis. This policy is in full accord with the principles of the American system of individual enterprise and will do much to smooth over the rough spots in the industrial readjustment to come. This in turn will simplify the process of readjustment of industrial communities and will therefore relieve the government of some part of that responsibility after the war.

These highly commendable actions should be studied and followed where possible by other manufacturers in aviation and other industries. They indicate sound management in times of emergency and will have the incidental value of making life hard for any competitors who are trying to make political capital of alleged profiteering in industry.

*Joseph E. Merrill*

Army command stripped for action, with Air Force attaining full status equivalent to combined ground forces. Ellenbourg raid start of belated Allied aerial offensive.

**P**RESIDENTY ROOSEVELT and his general staff made one of the important tactical moves in this world war when they stopped the Army down for action. With one devastating order the Commander in Chief reduced it to its three fundamentals: Air Force, Ground Force, and Supply. Most of the tagged military bureaucracy and trained cons of several generations were swept away with the stroke of a pen.

The various commands of Infantry, Artillery, Armored Force, are abolished. No longer do these all come under one command and agree what each will do. They get their orders direct from the Commanding General of the Ground Force. They are all coordinated by a single Command, his men on a chess board, with the single purpose of carrying out a mission. The Infantry, Artillery, Cavalry, etc., are not units and it is proper to refer to them as such, but not as branches of the Army. We are going to do this.

ALL RIGHTS RESERVED

Air Force, Ground Force, and Service or Supply appear to be equal in rank. They are autonomous, except that they are under a single command, the General Staff, headed by the President. These three divisions, like the various arms

sons of the Grand Force are grouped together for one purpose - to preserve our world as we know it.

You can think of the new Army as still another mix—and only two parts. One part is the fighting men—the ground troops and the air men. The other part is the supply arm, which designs, procures, delivers, and maintains the supplies and weapons for the fighting men.

The logic of this is obvious. Compare it with a job in a operating room. The surgeon is the man at the head, with a staff of experts handling him the tools he needs when he wants them. In our new Army the warriors will confer with the suppliers at odd times about how their tools work, and what changes should be made, but this is all. There is no leveling of authority.

Look at the effect of the reorganization on the Air Force. Since World War No. 1, the air arm of the Army has been pursuing its own plans. A few months ago the Air Corps was reorganized at the Army Air Force, with two divisions, the Combat Command, and the Air Corps. The Air Corps had charge of training, ferrying, personnel, intelligence, material. Thus, the Chief of the Air Force was responsible

## AMERICA AT WAR



Left to right: The commanders of the newly reorganized Army: Lt. Gen. Henry M. Arnold, Air Service; Lt. Gen. Lesley J. McNair, Ground Forces; Maj. Gen. Eugene S. Sweeney.

Service of Supply, and the new Naval Chief of Operations. Admiral Ernest J. Bieg, a flying officer. Antismoke and tape of decades was swept away with the reorganization.



These are the British parachute troops who paved the way for the devastating RAF attack on the Essen steel plant. Park is aiding in the destruction of a German radio direction post in Northern France.



The formidable force just carried by this parachute troop points up the true power of the British parachute battalions.

for the fishing, and processing, and everything else

**UNITED COMMAND IN AIR FORCE**

The new set-up abolishes the Air Corps. Aircraft was sent to a second almost entire that procurement of airplanes, including research and development, such as that done at Wright Field, was transferred to the Service of Supply, where the logic of the scheme seemed to indicate a belonged. This is indeed drastic reorganization—a housecleaning that reaches the hardware side from the staff, the high-level people from the rear, the abolition from the front and the simplified from the periphery.

Likewise, the Air Force Combat Command is abolished this morning of the 1st, 2nd, 3rd, and 4th Air Forces. You will recall that this command was the GHO Air Force since the recent formation of the Army Air Force. Now, the Combat Command is out, and the various wing reports to, and receives their orders directly from, the Chief of the Air Force. A number of other commands; training, fighting, etc., also report directly to the Chief of the Air Force. Thus, after growing up with the airplane as a fighting machine, General Arnold becomes one of the three new masters of the United States Army. (See page 167 first news item.)

Protagonism doesn't mean that we have the "Independent" air force which some statesmen suggest and others have been calling for. It is possible, even probable in the minds of some, that, as the vermining of war planes is developed, the air arm may take preeminence over all others. But it becomes increasingly apparent that we are not to have a separate air power in the war. To my horror, would be protagonists. As time is to be determined, there is now no separate air command in the world except RAF. That independence of course is not complete. And even if it were, RAF has several leaders chafed up against its British command.

While the Army Air Force, along with the Army, cut away its sweet drug, events abroad indicated it was high time for just such a make-over. American eyes were still on an action in the Far East, for it looks as if the Japs are our job.

## NAVY FOLLOWUP SURV

Following close on the heels of the Army changes, a reorganised and streamlined Navy Command was announced.

Agem, emphasis was placed on the air arm by the appointment of Admiral Ernest J. King as Chief of Operations. During the 1930's Admiral King held just about every command post in connection with naval aviation. He is one of the few high ranking officers credited as a naval aviator.

There is a close parallel between the new Navy staff organization and the Army set up. Admiral King's administrative staff will consist of Rear Admiral F. J. Harza, in charge of planning, organization, and procurement; and Rear Admiral Russell Wilson, supervising details of operations at sea. This set-up eliminates the overlapping and division of command that previously existed in the Navy-Husk Command.

ADTS SMALL WOLF THROATSTAY ROSE IN AIR

Nippon's air power figured badly in the conquest of the East. But now, after four months of war, indications arise that Japanese seems in the air to be largely at a loss of resources. They controlled the air in the Philippines, at Singapore, and in Java, because practically nobody else was in the air. This gave convenience for the Sons of Bataan will taper off, though, as more and more B-17's and other Allied craft show up on the other side. Long-range bombers are even more important now than ever, since they will have to hit from Australia and Alaska. They can also attack from Russia, if the Japanese tangle with that country.

EUROPEAN AIR WERE—ALLIED THIN

Observers had been wondering all winter what else happened to the projected British air assault on Germany and occupied Europe. Now, it seems that the long winter nights they were counting on were accompanied by awful weather. This has been pretty much true with the Russians and Germans also. Their airplane losses have been far less than their production, and it doesn't take a scientist to

(Continued on page 10)



High over the Andes, a Pan American-Boeing Airways DC-3 transport heads south for Santiago, Chile. It is by means of fast air communication for crossing the vast distances between the U. S. and the countries of South America that we are expanding our trade with Latin America.

## Aviation



Leonard E. Read

**Air transportation is playing the leading role in establishing vital trade relations and a good neighbor policy with Latin American Republics.**

THE PRESENT WAR has created a bond between the United States and our South American neighbors that is indelibly strong—at least for the present. The strength of this bond after the war depends principally upon trade, rather than political considerations. Then, as now, depends upon "facilitating trade" which means a willingness to trade through mutual understanding of benefits, and availability of communication and transport. And this is where our international activities will play the major role in insulating hemisphere relations.

The fact that this is a war of economy—a war in which the availability of materials is of paramount strategic importance, is coming to us to establish "trade facilities" at a speed and to a degree that would have taken decades to accomplish in peacetime with the slow methods of the world at our command. Commercial air transport is solving this emergency task, and expanded air transport on an economic, not a war, basis will perpetuate it.

Air transport has already played a large part in the enlarging of our commerce with South America. It has made possible the rapid exchange of written information and samples of products which businessmen require in formulating their plans. Of even more importance

is the service of air transport in making it possible for business, political and social leaders of both continents to visit each other and establish intimate personal and business relationships.

In order to do its part in providing such close personal and business ties, the Los Angeles Chapter of Commerce

has long been active in arranging air tours of South America by business and civic groups. We have also established business offices in Mexico City, Rio de Janeiro and Buenos Aires. Air transport makes it possible to keep in close touch with these offices and to which trade ties back to Los Angeles, with



One of the Pan American leading airlines in an open roadstead marine airport.

## Makes Good Neighbors

By LEONARD E. READ,  
General Manager Los Angeles Chapter of Commerce



The hub of Lima, Peru, showing the wide avenues and parks.

coordination samples to potential products sent back by return plane in time to reach business which could never be handled by any other method of transportation.

My trip around South America, prior to our entry into the war helped to give me a better grasp of the tremendous problems which have been precipitated by the war. The whole complex fabric of Latin American commerce had already

(Turn to page 224)

A Ford bi-motor flying over Santiago, Chile.

The DC-3 "Goody Luck" of PAA at the Lima Airport in Peru.



Modern apartment houses in Casapichan, a suburb of Rio de Janeiro.

# Healthy Workers Produce More

By HARVEY M. HALL



In the battle for production, improvement in the health of workers not only reduces time lost from the fight, but builds morale and increased efficiency. Nutritious food, sanitary precautions, recreation and health education speed the work.

**N**O ONE in wartime England doubts that absenteeism is an industrial warner as a grave problem. It can be placed on industrial accidents, which because of safety measures initiated since the last war have been reduced to a comparatively small number. According to British authorities, today's absenteeism is due, chiefly, to illness and lack of morale.

A program aimed at protecting and improving the general health of employees here as in England, it is believed, not only will reduce absenteeism due to illness but also will build morale.

Fatigue is an interesting cause of low production. It results in poor health and poor morale and its control improves both. As the all-out war program swings into high gear, measures to curb fatigue become of increasing importance. The experience of England may serve as a guide. Last year the British Ministry of Information reported that a plant manager had summed up the whole wartime situation when he said that "working a seven-day week means

paying for eight days (double pay for Sundays) and getting only one day's output." Accordingly, last summer, the Ministry of Supply recommended a three-shift system and the government later authorized a 40-hour work week with one day's rest, preferably on Sundays. Already the Ford Motor Company has had to revise working schedules. Long working hours, officials warned, "were found to have ill effects" on men producing aircraft engines. Their work accordingly has been limited to 38 hours a week with Sunday work eliminated.

In addition to efficiently planned work schedules, measures for men's strength incorporate both health and morale in the provision of proper food, correct clothing, sanitary and atmospheric conditions, intervals of rest, and so on. Personnel who has over looked both from the table after a satisfying meal and night "New 2 test proof" knows how good may be his morale.

The first large-scale attempt to assess (Turn to page 194)

Left: This, too, aids production. Ray Davis, West Coast aircraft worker, looks with awe at the massive Lockheed form. Below: More than 5,000 Lockheed and Vega employees working the "greenyard" shift posted the orderly ranks of Lockheed, Calif., when Ray Spurr broadcast his regular program from the aircraft plant.

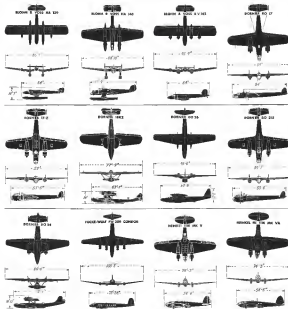


# German Aircraft

No less than 1,000 new military models have been produced in Germany since the outbreak of war in September, 1939. Known types used by the Nazis are derivatives of successful aircraft of pre-war development.

There has been much conjecture over the possibility of six raids by German long range bombers, undoubtedly the Heinkel 177. On paper this bomber has a theoretical maximum range of 7,000 mi. with a 100% bomb load. Condi-

tions should be given, however, to the fact that to increase the overall range of 1,953 mi. to this extent would necessitate the installation of huge fuel tanks in the fuselage. Bomb loadings would also have to be carried externally, thereby greatly increasing drag and reducing speed. Another unfavorable factor being European-based bombers is that strong headwinds always prevail over the North Atlantic which can spell failure for the mission.





# YOU CAN'T RECLAIM SCRAPPED TIME

RIGHT — THE STEEL  
TO AVOID WASTING  
SCRAPPED TIME  
ON A WASTE-PILE

There's some value in scrapped steel but no value whatever in scrapped time. That's an elemental thought but a profitable one to remember if you are placing an order for steel today.

Don't let inferior steel be a contributing factor to the time waste-pile. Buy the best steel available and save time as well as material.

**THE TIMKEN ROLLER BEARING  
COMPANY, CANTON, OHIO**  
Steel and Tube Division

## CONTRIBUTE TO VICTORY

By Saving Time and Material.  
The Best Steel Will Serve You  
Best Today—and it will con-  
tinue to serve you best  
after the war is won.

**TIMKEN**  
TRADE MARK REG. U. S. PAT. OFF.  
**ALLOY STEELS**

Manufacturers of Timken Tapered Roller Bearings  
for automotive, motor trucks, railroad cars and  
locomotives and all kinds of industrial machinery.  
Roller Alloy Steels and Carbon and Alloy Steels—  
low Sulfur, and Timken Road Bldg.

# MANUFACTURING SECTION OF AVIATION



## IN THIS SECTION

### PRODUCTION DESIGN RESEARCH ENGINEERING

Current Methods of Propeller Installation .....	Dr. C. S. Fiedler	62
New Gas Turbine Installation Features .....	Elmer Wheaton	65
Designing Propellers to Meet Performance Requirements .....	Ronald H. Warden	70
Producing Blanks for the P-38 .....	Wilbur C. Wood	74
Design Charts for Tubes Subjected to Bending .....	Walter C. Clayton	80
Choosing Alloys for Production .....	Fred Morris	85
Solving Power in Engine Testing .....	G. E. Cassidy	88
Strength Analysis of Bolted and Riveted Joints .....	Wayne A. McGowan	91
Escher Wyss Variable Pitch Propeller .....	Dr. C. Keller	100
Synthetic Events in Construction, Part II .....	M. H. Hunt	103
Dr. Haviland's Counter-Rotating 4-Bladed Propeller .....		106
Broken Production from Skimping .....		106
Review of Aviation Patents .....		109
AVIATION'S Sketch Book of Design Details .....		112
New Products and Equipment for the Aviation Industry .....		118
Window Shopping .....		135
Subcontractors Section .....		139

MANY of the first Plexiglas installations on military aircraft are still serving active service. Time and war and weather have made only minor inroads on the transparency and dimensions of the material, changes of only academic interest.

Plexiglas has proved its permanence even under severe weather conditions—frequent, low-level, that it has been properly installed.

When proper consideration has not been given to the properties and limitations of the material, Plexiglas has occasionally cracked or crazed. Usually it has not failed so fast as other types of transparent plastics fail under more favorable conditions, but in such cases it has not given the long service which designers have come to expect of it.

Since correct installation is so essential for satisfactory service, this article is aimed in that direction. It not only contains specific suggestions for installing Plexiglas but outlines the considerations behind these designs. It does not pretend to exhaust the possibilities of the subject, but it does lay down basic principles for the guidance of the designers, engineers and production personnel for whom it is written.

**PRINCIPLES OF SUCCESSFUL INSTALLATIONS**  
 "Plexiglas" is the registered trademark for the acrylic resin transparent sheets and rods manufactured by the Bofco & Huse Co. It has been met and passed the following specifications:  
 U. S. Army—"Plexiglas Sheet, Acrylic Resin," 94-120143  
 Navy—"Acrylic Resin," 94-120143  
 Navy—"Acrylic Resin," 94-120143

Just as windsight and optical crack around an area of high localized stresses on Plexiglas and other transparent plastics are apt to develop a pattern of fine fissures under similar conditions. This effect, called crazing, can best be seen by looking along the surface of the sheet.

Crazing occurs when differences in stresses between the surface and the interior of the plastic are sufficient to crack it "down." An airplane installation may create just such differences by bringing large forces to bear on limited areas of the Plexiglas.

There are two simplified internal

stresses in flat Plexiglas sheets. Located every point is subjected to a tensile stress (similar to stretching in glass) in the plane of its manufacture. This process developed by the Bofco & Huse Laboratories eliminates any unbalanced stresses set up during the cutting of the sheet. In effect it prestrains the material so that no further significant dimensional changes take place in spite of weathering and other service conditions.

Small local stresses may be set up by screwing or fastening Plexiglas, but these are of no great moment unless a considerable area of material is involved. To a serious extent, stresses are also set up during the forming of a Plexiglas sheet into a curved section. If the material is even reasonably hot when formed, however, these stresses are well distributed throughout the section. Crazing may occur in a formed piece when a solvent for Plexiglas attacks the surface and releases some of these stresses temporarily. This may happen, for example, when a cleaner containing such a solvent is used on a finished cockpit enclosure.

Neither weathering alone, however, nor other service conditions cause of solvent action cause crazing even to a piece of Plexiglas which has been in-



Figure 1. Accelerated crazing tests for Plexiglas.

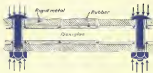


Figure 2. If metal channel members were perfectly rigid, stresses applied to the sheet would be distributed evenly over the supporting areas of Plexiglas. Absolute rigidity may be impractical in light-weight installations but the stiffer the members the better the stress distribution.

stably stretched during forming. Crazing reduces the transparency of a plastic, but, more important, it is a symptom of a nearly high stress differential and a warning that the material has been seriously weakened. A crazed plastic section should be replaced as soon as possible. It is not enough to remove the cause merely by light local heating or by other expedient methods. The condition which caused the crazing must be remedied if continued service is expected.

#### CAUSES OF CRAZING

To determine the stress differential at which crazing develops, strips of Plexiglas 24x24 in. were placed in racks arranged as in Fig. 1. Various weights were hung at A to produce center fiber strains of approximately 336, 1,000, 2,000 and 4,000 lb. per sq. in. These stresses were calculated from the following formula, based on a 24-inch side:  $P = \frac{WL}{24L}$  where L is the load at A.

As a guide, W is the width and T is the thickness of the strip in inches.

Two racks were used; one was placed in a dark closet, the other was exposed to the weather from August to January. The results, summarized in Table 1, led us to recommend a maximum stress of 600 to 1,000 lb. per sq. in. if extended outdoor service is expected of the Plexiglas. Since, within this limit, Plexiglas retains its original transparency and strength satisfactorily, every effort should be made to keep stresses below the given maximum as much as feasible to insure the anticipated service conditions.

#### AVOIDING EXCESS STRESSES

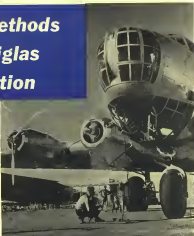
The channels were to avoid excess pressure on any part of the Plexiglas as to distribute the total stress over as large an area as practical.

Thus the usual method of mounting Plexiglas is in an extruded or molded channel. Here stresses are distributed, to a certain extent at least, all along the edges gripped by the channel. Naturally, the deeper the channel the larger the area carrying the total stress. Variations in the thickness of the Plexiglas (usually 1/8 percent) and in the width of the channel, provide absolutely equal distribution of stress, but when reasonable care is taken to keep the changing stress uniform all along the frame, excess pressure at any one point can be avoided.

Unfortunately, it is not always possible to use a single channel or clamp mounting. At high speeds, say five miles per hour, thin sections cut of the channel unless it is backed or riveted or unless some other retaining device is used. A high cranked section may also require positive attachment.

## Correct Methods Of Plexiglas Installation

Plexiglas has proved its permanence during years of service under severe conditions, but proper installation is essential to provide such satisfaction. Here are the basic principles to guide designers and engineers who are responsible for providing methods of installation.





protect the Plexiglas from direct pressure. Similarly, it is also possible to use long shafts bolts or shoulder straps or cap nuts to make it impossible to bring the channel members closer together than the thickness of the sheet into a reasonably tight fit for channel variations and for rubber packing. Thus, without complicating production practices, it is possible to provide protection and assure longer service for the Plexiglas.

#### FUNCTIONS OF RUBBER GASKETS

It should be pointed out that the rubber gaskets recommended as best Plexiglas sealants do not fully represent developments of high stress seal concentrations. Their principle functions are these:

- 1 To make the installation water-proof.
- 2 To reduce vibration.
- 3 To help compensate for thickness variations in the Plexiglas and width variations in the channel.

They help distribute stresses only to a degree extent and only when the stresses are large. These rubber strips are not only to transfer these loads out small area in another small area and to reverse their direction so that they act almost as shear against the original pressure, as shown in Fig. 4. This is less apt to be true of these soft rubber gaskets, but it is entirely possible for rubber to produce stress conditions which will cause the Plexiglas to fail as an installation which might otherwise be satisfactory.

#### CASE IN INSTALLATION

When these precautions may be reduced to an ever-increasing mechanical design to install a Plexiglas section "good and tight." All too easily a man can screw a nut and bolt tight enough to develop more than 1,000 lb. sq. in. pressure on the plastic. Or he can force a section for not of shape in fitting it into a frame, thereby setting up high and unequal stresses.

Workmen should therefore be instructed to avoid strong arm methods in installing Plexiglas sections past so they should be worked against starting by surface. It may also be possible to begin down with tension wrenches so that forces over a given limit cannot be applied to a nut or screw. If this is not practical, correct assembly men to tighten such screws or nuts—and then to back it off one full turn.

#### WAVE UP THE SPACES

It is the better part of wisdom, however, to design an installation which cannot put the Plexiglas under any great pressure.

One good solution is to provide tabs spacers to aid against the bolt and thereby

be satisfied with ease since they may contract against the Plexiglas. It is a simple matter to make a small rectangular piece of Plexiglas with the material for several days and then to machine it for leveling or evening. This rough preliminary trial should be followed more complete and controlled tests.

#### EXPANSION AND CONTRACTION CLEARANCES

The coefficient of expansion of Plexiglas is  $30 \times 10^{-6}$  per degree F, which is higher than the coefficients of materials with which Plexiglas is apt to be mounted. This difference means that dimensional variations in the Plexiglas to expand or contract in relation to the expansion of the metal frame, or bending and dangerously high stresses will result.

When a simple, hollow channel section is used, Plexiglas can expand and contract easily by slipping along the channel—unless, of course, the channel clamps the material too tightly or any part.

With medium sized pieces, it is possible to bolt at only one end and to allow the expansion to be taken up by slippage at the other end. With larger pieces, it may be preferable to bolt at the center of the long edge providing for expansion and contraction at each end. If the Plexiglas piece is free to expand in both ends, only half the total expansion clearance need be provided at each end.

Wherever the size of the section or design of the frame allows it necessary to drill holes through the plastic and bolt or rivet it to supporting members, the holes in the plastic must be made so as to allow some movement of the plastic relative to the metal frame. If the holes in the frame and in the plastic are drilled at the same time, the plastic should be removed and the holes re-drilled to the larger size. This over-size hole may be made necessary to the steel in the frame so that the bolt or rivet does not bind at one edge, causing cramping or failure at these holes.

In sections of hemispherical shape which are to be installed in a flat frame section, expansion changes will cause the spherical section to expand or contract as unsupported area. These changes of contour have great to transfer with Plexiglas sections up to 48 in. in diameter, but it is important that provisions for radial changes be made at the circumference, where the section is attached to the supporting frame.

Eliminating the hole in the supporting attachment is one possibility. Another successful design calls for connecting a Plexiglas member ring all around the edge and following the completed holes in this ring. The ring also gives rigidity

to the section which facilitates handling and reduces breakage in installation.

#### CALCULATING CLEARANCES

For example a high altitude plane with maximum temperatures as low as -80 deg. F, or as high as 140 deg. F, as service. For a sheet installed at 70 deg. F, expansion and contraction dimensions would therefore be calculated as follows:

Coefficient of expansion (°F)	0.000030
Temperature	10
Length (inches)	100
Change in length (inches)	0.0030
Allowance for expansion and contraction	0.0060
Minimum clearance	0.0060

Similarly, for a 150 deg. F drop in temperature, a contraction factor of 0.0045 (or 0.003) is obtained. These factors, multiplied by the length of the Plexiglas panel are specified for clearance in the design.

In calculating clearance for the radial expansion and contraction encountered at the edges of hemispherical sections the diameter is multiplied by the above factors to determine the length of the elongated hole.

#### RECOMMENDED THICKNESS AND FACTORS

The determination of the proper Plexiglas thickness for any given in-

stallation is dependent on many factors, most of them beyond the scope of this article. To mention a few of the more important ones, the size, for example, is important because the more completely the panel is supported, the less the Plexiglas that can be used. The following table may serve as a rough general guide for flat panels.

Thickness	Maximum recommended span
1/8 in.	12 in.
3/16 in.	18 in.
1/4 in.	24 in.
5/16 in.	30 in.
3/8 in.	36 in.

Shape is also a consideration, for a long narrow panel tend not to be thick as a square panel of the same area. Clearance should also be considered, since over a slight load in Plexiglas will add to its rigidity and strength. It should be remembered, however, that forming a three-dimensional section, the Plexiglas is installed and is thereby stressed to a degree dependent upon the extent of the section.

Ribs provided in the panel will also aid rigidity and strength, according to the thickness and position of the ribs. The method of installation will in itself affect the choice of thickness in many ways. If the edges are to be riveted, moderately thick Plexiglas will automatically be required, although increasing rib strength along these edges will make possible the use of thinner material in the rest of the panel.

If the Plexiglas is installed in a deep

channel, the panel may be forced through quite a wide range without peeling out, a more shallow channel will require more rapid (thicker) Plexiglas. If the panel is banded, it is less likely to peel out (thinner material) may therefore be used.

The pressure differential between one surface of the panel and the other is obviously important. In aircraft installations, this factor is dependent on aerodynamic considerations which are, in turn, dependent on the location of the panel on the plane and on the speed of the plane. Since the theoretical maximum differential in these cases is approximately 10 lb. per sq. in., we have determined the deflection caused by this pressure at the outer of 12-in. diameter disks of Plexiglas of various thicknesses. The data given below is intended only as a general guide. In all installations, the designer should consider all of the other factors mentioned above.

Thickness of disk of Plexiglas	Deflection of disk in inches with maximum pressure
1/8 in.	0.01 in.
3/16 in.	0.008 in.
1/4 in.	0.006 in.
5/16 in.	0.004 in.
3/8 in.	0.003 in.

#### CHANNEL AND CLAMP MOUNTINGS PART 1 OF 2

Wherever possible, avoid bending or twisting through labor drilled in the Plexiglas. Channel and clamp installations are usually preferable from the point of view of mass production methods and are definitely superior in distributing stress.

In this type of mounting the principle precautions are:

- 1 The channel should be oversized to prevent free lateral expansion and contraction of the Plexiglas relative to the frame.
- 2 When installing Plexiglas, care should be taken to keep the clamping members even all of the area clamped.
- 3 The channels should be deep enough to hold the Plexiglas securely despite flexing and thermal contraction. A safe rule is to install channels, partly up to 12 in. in area should extend into the channel 60 in. plus the contraction clearance (.402 in. times the length of Plexiglas); larger panels, 10 in. plus contraction clearance.

In calculating these dimensions, remember that linear sewing differences for Plexiglas are  $\pm .005$  in. for panels up to 12 in. and  $\pm .006$  in. for longer panels.

#### SIMPLE CHANNEL INSTALLATION PART 2

The principles behind the type of installation shown in the sketch apply to both D channels and U-channels. No bolts, wires, or rivets pass through the

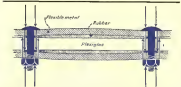


Figure 3. Possible metal strips when applied stresses to concentrate on the Plexiglas around bolt holes. In practice, all channel members are apt to be somewhat flexible—these the need for supports and other devices to protect the Plexiglas from direct pressure which may cause cracking and failure.

Figure 4. Compressive stresses applied at under are transferred by rubber gasket into lateral stresses acting on the Plexiglas at edge of washer.



# FLUSH CHANNEL INSTALLATION

Figure 4

One of the advantages of Plexiglas is that it can be coated along its edges to make possible the type of mounting shown here. The Plexiglas is held securely by the outside channel in flush with the mounting frame.

The corner of the shoulder of the root should have a slight radius to reduce the danger of a crack's starting at that point. The fabricator can produce this effect by grinding down the sharp edge of the root corner.

The outer rim can be adjusted to maintain close tolerances ( $\pm .001"$ ) in either the depth or the use of the outer rim. Because of thickness variations in the sheet, it is not possible in a single setting operation, to maintain these tolerances in both fit and depth. When both these dimensions are critical, a second grinding operation is necessary—using a corresponding groove on following coats.

# FLUSH INSTALLATION WITH SEE

Figure 5

Plexiglas. When joining or reinforcing the channel involves the use of such fasteners, the edge of the Plexiglas is cut out to avoid them.

A self-reinforcing channel, as indicated in the sketch, makes for faster assembly than sharp-edged channel members and reduces the danger of scratching the Plexiglas during installation.

In assembly, use rubber strips coated with adhesive on one side. This fastening can be quickly be wrapped around the edge of the Plexiglas and will stay in place while the panel is being inserted.

The Plexiglas may be gripped more securely—without reinforcing the advantages of a flush mounting—by reinforcing ribs in contact to the edge and clamped as shown in the sketch.

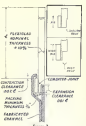


Figure 5

The relation between the depth and shoulder of the root, and the width and thickness of the ribs is complex and cannot be set down as hard and fast rules. If possible:

(a) The minimum thickness at any point in the Plexiglas assembly should

not be less than the thickness of the Plexiglas panel.

(b) The ribs should be roughly twice as wide as the thickness of the Plexiglas, since the tensile strength of Plexiglas is approximately double its shear strength.

(c) The ribs should not be the same width as the root, i.e., the edge of the rib should be opposite the end of the root, if concentration of stresses at this point is the worst to be avoided.

# ANNULAR RING INSTALLATION

Figure 6

For strengthened sections such as roots and gun barrels, the type of annular rings shown here has proved successful.

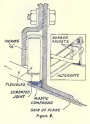


Figure 6

A Plexiglas annular ring is mounted around the whole circumference of the root or shell. This arrangement must first be tested as shown in the sketch so that the two surfaces to be cemented together will be flat and so that the rib will not slip while the cement is setting.

Most of the stresses set up in service will be along the Plexiglas shell, as indicated by the arrows in the sketch. The annular ring acts as a lever, multiplying the bending moments on it, as the metal clamping ring. To eliminate this lever action, the edge of the ring should follow, as closely as possible, the point between the annular ring and the shell.

In pressurized shell assemblies, the better action may be used to advantage by inserting round rubber rings at the welded joints. As pressure increases, these gaskets become tighter and hence seal the joint more effectively.

The outer edge of the Plexiglas shell is coated so that the section may be

installed after the metal work is completed and so that it may expand rapidly.

# PATENTED CHANNEL INSTALLATIONS

Figure 7

The patented frame shown here is an extension of a number of design installations which have proved practical on many planes.

It consists of an aluminum extension which is bolted or riveted to the skin of the plane. A reinforced fiber tape is put in position around the inside of the frame and the Plexiglas placed against

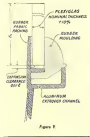


Figure 7

that tape. Then a heavy rubber extension is slipped into position to hold the Plexiglas in place. This extension is so designed that any one of a number of thicknesses of Plexiglas may be used without changing the dimensions of the aluminum or rubber parts.

Notice that the Plexiglas is held by the uniform clamping action of the rubber and that the possibility of buckling up concentrated stresses is therefore quite remote. This type of mounting is satisfactory for permanent cabin installations as well as for low altitude planes.

<sup>1</sup> Reinforced through the center of the Water-Tight Channel. <sup>2</sup> Patent 2,174,400. A number of variations of this principle are used, such as the following and have other advantages over the annular assembly.

# WEDGE SECTION INSTALLATIONS

Figure 8

When two Plexiglas panels must be located edge to edge and supported along three edges, the type of installation shown here may be used.

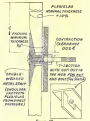


Figure 8

The aluminum extension is in the shape of a very flat wedge so that either piece of Plexiglas may slide along it freely when expanding or contracting.

It also has a shoulder to prevent uneven pressure on the Plexiglas. This shoulder bolts directly to the reinforcing member, a T-shaped beam with cut-outs for the web for the nut and bolt.

This type of installation is, of course, possible only with thicker Plexiglas sections where the edges of the sheet can be located. This bearing allows possible a flush outer surface, an advantage over the H-channel installation shown in Figure 9.

In practice, this type of mounting is often used only on one or two sides of a Plexiglas section, the other sides being mounted in a channel or by some other method.

# WET-AND-DRY AND RIB MOUNTINGS

Figure 10 to 12

When special considerations make channel and clamp mountings impractical, holes may be drilled in the Plexiglas for nut-and-bolt and rivet installations. To secure best service, special consideration should be given the following factors:

1 Use as many bolts or rivets as practical.

2 Distribute the load over as equally as possible among these bolts or rivets.

3 The holes drilled in the Plexiglas should be sufficiently larger than the diameter of the bolts to permit expansion and contraction of the Plexiglas relative to the frame.

4 The holes in the Plexiglas should

be concentric with the holes in the frame so that the greater relative expansion of the Plexiglas will not cause loading at one edge of the hole.

5 Use cross-hatched spacers, should der bolts or rivets, cut into or some other device to prevent the Plexiglas from direct pressure in installation.

# RIB AND SPACER INSTALLATION

Figure 11

This type of installation can be used with either a bolt or a rivet as the positive attachment. A rubber spacer protects the Plexiglas from direct pressure. Since the spacer is inserted after the Plexiglas is in position, assembly is quite simple.

A modification of this installation calls for the use of a long-shank screw or shoulder screw. This modification would differ from the remaining shown in Fig. 11 in the holes drilled in the metal channel members. Here both holes are of the same diameter; in Fig. 11, one hole must be smaller than the other one.

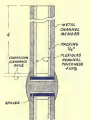


Figure 11

The length of the spacer is calculated to allow for variations in the width of the channel, in the thickness of the Plexiglas and of the rubber padding.

Notice that construction clearance is allowed around the bolt so that in case of extreme temperature change, the Plexiglas is not too hard and cracks at one edge.

In this and other rivet and bolt installations, the recommended distance from the hole to the edge of the Plexiglas is the same as the recommended depth of grip in the channel installations.

## BOLT AND SPAGNE INSTALLATIONS

Figure 12

Another method of mounting, which also makes use of a tubular spacer to protect the Plexiglas, is shown here.

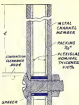


Figure 12

In this case the spacer is equal to the inside width of the channel. This permits the use of conventional screws as well as nuts, without reducing the

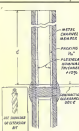


Figure 13

protection to the Plexiglas.

It is somewhat more difficult to assemble than the method shown in Fig. 11, but satisfactory results can be obtained, out to about the space in relation.

## SPAGNE RIVET INSTALLATION

Figure 14

To eliminate rattle, it is possible to use a shoulder spacer as shown in this sketch. A shoulder screw could, of course, be used as the main ring.

This mounting requires that the rivet hole in one channel member be larger than the corresponding hole in the other member. Each member may be drilled separately and assembled later in a jig so that the holes are concentric. To drill both holes in a single operation (after the channel is assembled) does not require a number of special bits available, however, variously as shoulder, conical, self-drill, drill bit, counter-bore, conical, or step drill. The sketch illustrates one type of standard drill-bit set.

## ANGULAR BIRD AND BOLT INSTALLATION

Figure 15

Like Fig. 8, this type of installation is especially designed for hemispherical sections such as tanks, gun barrels, and aircraft's domes.

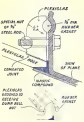


Figure 15

A strip of thick Plexiglas is machined to the indicated cross-section and then formed to follow the circumference of

the section. This circumference is also marked on the inside, so that it will fit the smaller ring on the outside on, that it can be located after all small work is done. The ring is connected to the section and the required holes drilled through it from below.

The doublet nut and the shape of the ring permit the section to be slightly offset when the cable is pre-tensioned or when the Plexiglas expands or contracts. The rubber gaskets under the installation pressure tight. So that excess pressure will not be put on the ring, the bolt is threaded along only a small part of its length.

## BOLT INSTALLATIONS FOR SMALL SECTIONS

Figure 16

For small Plexiglas sections carrying very light loads, the simple installation shown here may prove satisfactory. It

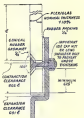


Figure 16

should not be used under any other conditions.

In any event it should be used only when a snap nut, long-shank shoulder screw or some other device is used to prevent pressure on the Plexiglas. The coiled rubber gasket does not offer sufficient protection for the Plexiglas.

Notice also that the head of the screw should have a flat angle. A shoulder angle concentrates the weight action of the screw head which tends to split the Plexiglas.



Fig. 17. Actual photograph of workman at the Douglas factory assembling the insulation to the wings with Speed.



Clip. Fig. 18. Workman here one inserting the fast hook in the wing.

# New Gas Tank Insulation Fastener

By ELMER WHEATON

Author: Elmer Wheaton, Douglas Aircraft Company, Inc.

UNTIL QUITE RECENTLY it had been our custom to insure gas tank insulation in the wings in our stock landers by means of a special cement or mastic coating. While this method of insulating was satisfactory, we felt that it could be improved.

In discussing this possibility of improvement with the subcontractor we succeeded in securing from them an expensive new Speed Clip that we changed into position to hold the insulation and avoid the use of cement or mastic coatings. These Speed Clips are formed so that they may be stepped in place to hold the insulation firmly in position during and prior to the installation of the fuel tank gas tank.

We found the Speed Clip worked better and faster. This clip being made of 303 stainless steel with chrome primer coating, holds the insulation to the wings indefinitely without corroding. Many men have perished here already here used under the adoption of this new assembly method. The process of manufacture of these Tensar

Speed Clips is equally as interesting as their application. Cuts of 303 stainless steel rods are fed into high speed presses where they are formed in various shapes, as shown in Fig. 4.

After the Speed Clips are formed they receive a coating of zinc chromate primer.

Fig. 5 shows how the clips are placed in racks to prevent distortion prior to

final inspection and packing. The clips are given one hundred percent inspection on a test gage as shown in Fig. 6, then carefully packed in "egg crate" type boxes for shipment.

This is but one of the many ways in which subcontractors have employed their engineering and production facilities in the advancement of aircraft assembly.



Fig. 19. Showing how Speed Clips are pressed under the insulation with the rounded heads of the clips occupying over the edges of the "fast sections" or channel supports to hold insulation snugly in place. Note how top surface of the clip is smooth, with corners rounded down, to permit sliding the fast hook into position without snagging.



Fig. 20. Showing how Speed Clips are pressed under the insulation with the rounded heads of the clips occupying over the edges of the "fast sections" or channel supports to hold insulation snugly in place. Note how top surface of the clip is smooth, with corners rounded down, to permit sliding the fast hook into position without snagging.



Fig. 21. Showing how Speed Clips are pressed under the insulation with the rounded heads of the clips occupying over the edges of the "fast sections" or channel supports to hold insulation snugly in place. Note how top surface of the clip is smooth, with corners rounded down, to permit sliding the fast hook into position without snagging.



# KOLLSMAN

## AIRCRAFT INSTRUMENT INFORMATION MATERIAL

**DISCOVERED** on this page are the various types of informative material on instruments made available by Kollsman to men engaged in aircraft work today. Each page is designed for use in some particular phase of instrument operation, servicing, or maintenance.

**As presented** in growing more information about aircraft instruments, read about the designers of the material and select that which meets your need.

**FREE** to anyone interested in aircraft instruments... the booklet "Items About Kollsman Aircraft Instruments." In writing for information, give your instrument number as it appears in the manual and we are going to put it where it will do the most good.

**HOW TO OBTAIN YOUR MATERIAL.** Check the coupon and fill in your name and address and connection. Mail to us as the coupon address.



SENT WITHOUT CHARGE TO PURCHASING, MAINTENANCE AND INSTALLATION MEN, ENGINEERS AND DESIGNERS



**ITEM 2 "Kollsman Catalog"**  
 Useful on only in purchasing materials—the catalog also gives complete data on every instrument (type, size, range, operating characteristics, etc.) supplied by engineers and designers. Information on accessories and their installation is included. Complete with price list. Lockheed booklet.

AVAILABLE TO GROUP INSTRUCTORS AND MAINTENANCE STATIONS FOR REFERENCE



**ITEM 4 "Instrumental Unit Chart"**  
 Size, 8 1/2 by 10". Set of four separate charts contains mechanics to deal with diagnosis of operation. List of eight charts covers following: (1) Kollsman Instrument Assembly; (2) Kollsman Instrument Assembly; (3) Kollsman Instrument Assembly; (4) Kollsman Instrument Assembly; (5) Kollsman Instrument Assembly; (6) Kollsman Instrument Assembly; (7) Kollsman Instrument Assembly; (8) Kollsman Instrument Assembly.



**ITEM 5 "Kollsman Handbook"**  
 110-page booklet covers detailed books, giving detailed information on the construction, operation, and servicing of the instrument. Contains with charts and diagrams on the construction of the instrument and its operation. Also contains a list of the instruments and their specifications. Price, \$1.75 each.

**ITEM 6 "Kollsman Maintenance Manual"**  
 Available to Instrument Repair Service.

**ITEM 7 "Test Specifications"**  
 Lockhead booklet, in series, covering the various types of Kollsman instruments. Contains complete data on every instrument (type, size, range, operating characteristics, etc.) supplied by engineers and designers. Information on accessories and their installation is included. Complete with price list. Lockhead booklet.

**ITEM 8 "Items About Kollsman Aircraft Instruments"**  
 The valuable catalog contains 140 pages of complete information on every type with price lists for all of the specified types of Kollsman instruments. Principal parts diagram, general parts list, and specifications are included for each instrument. Material is presented in a way that is easy to read. Price, \$1.75 each.

**ITEM 9 "Items About Kollsman Aircraft Instruments"**  
 The valuable catalog contains 140 pages of complete information on every type with price lists for all of the specified types of Kollsman instruments. Principal parts diagram, general parts list, and specifications are included for each instrument. Material is presented in a way that is easy to read. Price, \$1.75 each.



can be of major importance, particularly if the surface is to be operated from unimproved fields. A typical design of a Curtiss electric propeller with hollow steel blades is shown in Figs. 3 and 4.

From the results of the aerodynamic propeller performance study conducted by the propeller engineers, and bearing in mind other factors listed above, the aircraft designer proceeds to evaluate the propeller performance using the most suitable propeller efficiency, that is, usually, he makes the final decision as to which model propeller will be specified.

If the propeller selected is a new design it must necessarily pass a rigid test stand modern test, usually conducted with an electric windmill, to be approved by the CAA, Air Corps or Bureau of Aeronautics. Even though it is a current production model, as a new design installed on a certain model engine for the first time, it must meet stringent stress tolerances for approved use, usually disclosed under trial flights on the "X" model or first airplane of that installation.

In the case of the Lockheed P-38 (Fig. 6), it was found best that a three-bladed hollow steel propeller be used and that the left propeller should rotate counter clockwise and the right propeller rotate clockwise.

On the Martin B-26 medium bomber (Fig. 7), both propellers are four-bladed hollow steel types and rotate clockwise. Due to the power output of these engines and the limited propeller diameter, it was advantageous to utilize the higher velocity rate of the four-bladed propeller.

Now that the propeller itself has been selected it is necessary to determine the type of propeller control system most suitable to the aircraft under design. The Curtiss electric propeller installation provides great flexibility in this respect, inasmuch as any one of the three general control systems is readily adaptable to various types of installations. As will be noted (Figs. 3 and 4).

A remarkably small amount of wiring and control circuit is required for the proportional governor system, which is usually the most desirable in single- and two-engine airplanes.

The automatic synchronizer control system, (Fig. 2), has certain definite advantages and is in most general use on multi-engine airplanes.

Another Curtiss electric propeller control system which is sometimes used is the remote control governor type. This system permits governor regulation by operation of an electric control rather than by a governor level control.

Any one of the propeller control systems can incorporate automatic stall warning, but rate stall warning which requires the voltage booster shown in Figs. 2, 3 and 4) or no stall warning device at all. The latter feature is usually provided in all installations except the single engine type.

To determine the application of the most control system, it is essential that the engine governor drive ratio, its direction of rotation, and voltage of the electrical supply system be known.

The selection of a specific control system is determined by considering which is the most applicable and efficient for the weight and cost involved. As in the case of some multi-engine airplanes

the synchronizer system may be preferred over the proportional system, or remote control governor system due to the automatic synchronization feature. Since each installation presents its particular problems a complete cost study is necessary.

On some airplanes, reverse pitch is often desired to improve airframe maneuverability. In the case of the larger type airplanes it is usually desirable to provide dual control panels for the pilot and flight engineer. Such dualisms from standard control systems are not unusual and can naturally be incorporated into the control system.

Recent trends in new airplane development have been toward the use of ground test rigs which duplicate power plant installation details and permit testing in advance of installation on the airplane. Preliminary propeller blade vibration tests and control tests can be conducted as part of the test program on the ground rig.

### FUNCTIONAL PROPELLER ASSEMBLIES

It can now be assumed that the basic propeller and its controls have been designed and fabricated in accordance with the airplane and its engines, all of which are now ready for the initial propeller installation.

Aerodynamic operators are almost invariably specified for liquid-cooled engines, inasmuch as the combination of the spinner and cowling increases the high speed efficiency by reducing the profile drag. The use of spinners is becoming more general for air-cooled engines, particularly on the high speed type airplanes, where improved engine cooling is required. Figs. 5 and 6 illustrate typical spinner modifications on the liquid-cooled and air-cooled engines, respectively.

Blade stall cells, which recently have been developed, are specified for the most part on air-cooled engines so that their effect has been to increase the flow of air through the stall at low speed, which will in engine cooling. (Turn to page 202)



Fig. 5. A partially assembled three-blade hollow steel Curtiss electric propeller.



Fig. 6. Lockheed P-38 interceptor equipped with Curtiss electric propellers.



Fig. 7. Martin B-26 medium bomber equipped with Curtiss electric propellers.

# Producing Struts For the P-38

By WILBUR G. WOOD

Chief Engineer, Aircraft Strut Division, Mooney Manufacturing Co.

This article on the production of landing gear struts for the Lockheed P-38 interceptor is a dramatic illustration of the contribution which can be made to military aircraft production through subcontracting.



1 Cleanup of Lockheed P-38 showing features of main and nose struts of the landing gear.

NOW ROLLING OFF the production line as rapidly as ever, the Lockheed P-38 interceptors are carrying much of the load of defending American forces against bomber attacks. And all of the load is taking off or landing the P-38 is carried by the landing gear, which is of aircraft type. Both main and nose struts for the P-38 landing gear are manufactured by a subcontractor, to Lockheed design. The P-38 landing gear is characterized by its simplicity and ruggedness. Not only does this insure reliability in operation, and simplify maintenance prob-

lems, but it helps speed maintenance. Usually there are but two joints in the P-38 main landing gear strut. There are the strut cylinder, which is attached to the splashpan structure, and the piston which operates in the cylinder and which carries the wheel at its lower end. Of course there are numerous auxiliary parts required for full operation. Contrasting with the extreme simplicity of the piston-cylinder combination is the rather complex practice of attaching the strut into a load carrying member and a shock absorbing unit, resulting in many more parts. Some

foreign designers also prefer to use heavy rig springs in the strut to carry compression loads, instead of relying on air pressure, as is standard American practice.

## MANUFACTURE IS SIMPLE BUT HIGHLY CONTROLLED

In order to justify its simplicity of design and manufacture the P-38 type strut must give reliable service. This requires that manufacturing be conducted with extreme care and accuracy. Such manufacturing care must include precise heat treatment and removal of stresses, in addition to a high quality of machine work. Two examples of operations other than machining will illustrate this. In heat treating and tempering the struts they are loaded in special furnace equipment which permits them from room temperature and so practically eliminates scale formation. This insures substantially to close control of dimensional tolerances. A further example is the annealing of hard chrome plating on the wearing surface of the piston tube. The plating is first heated in a bath, then ground to close tolerances and finally buffed. Final operations are hard chrome plating to within .002 of specified diameter and finish.

Importance of machinery to production of the P-38 strut is illustrated by comparing rough and finished weights of the major strut parts. The strut cylinder, a heavy seamless steel chrome molybdenum tube, weighs 188 lb. in the rough and only 45 lb. when finished, including the weight of two lapped bars which are welded on in the course of manufacture. The piston member is produced from a forging which weighs 136 lb. in the rough and only 38 lb. finished, including a torque flange which is welded on.

## STRUT CONSTRUCTION

Since the P-38 landing gear is of the cycle type the main landing gear struts are located in rear of the C.G., being attached to the splashpan structure by a fulcrum. The struts are semi-collapsible, with drag braces running from about the mid-point of the strut, and side links actuated by brace struts extending up and outward from the same mid-point. Flexing resistance is accomplished through a hydraulic cylinder operating on the drag strut, driving the landing gear backward and up into wheel wells which are fully closed when the gear is retracted. These brace struts and the actuating cylinder are not produced by us, permitting us to concentrate all our production facilities on the strut system.

There are two main chambers in the strut cylinder, the piston being operating in the lower cylinder, which is filled with oil, while the upper chamber serves



2 A completed main strut for a P-38 landing gear.

as an air chamber. The piston has a diameter of 4 in. and a stroke of 10 in. Between the lower and upper chambers is an orifice plate which also serves as a stop when the piston is fully deflected. Oil fills not only the lower chamber, but extends 3 in. above the orifice plate into the upper chamber, the balance of the chamber being filled with compressed air. Forcing the oil through the orifice produces a "cushioning" action which works in either direction to take the initial shock, reduce rebound, and produce a smooth landing shock absorbing cylinder. Reverse oil control in the upper cylinder is chiefly a safeguard against leakage, to insure against loss of oil which would remove the orifice and impair proper functioning of the strut.

Overall length of the strut is nominal



3 Above: Special Moench angle lathes equipped with pre-flin bar for turning multiple G.E.'s.

4 Right: Welding lag forgings to strut cylinder.



position is 49 1/2 in. from center of the upper fulcrum to center of the wheel axle. Maximum G.D. of the strut is 1/4 in. Both the cylinder and piston are of chrome molybdenum steel which is heat treated to a strength of 180,000 psi minimum. Bronze bearings are provided on the upper end of the piston and lower end of the cylinder so that sliding parts in contact remain in bronze against hard chrome plate or steel. Retention of the hydraulic fluid is by means of chrome type packing incorporated in the lower end of the cylinder, just above the bearing. Proper alignment of the wheel axle is maintained by torque links connecting the piston with the cylinder.

The piston member is machined from a solid forging which incorporates a knuckle at the lower end. This knuckle is forced out to receive the wheel axle, which is pressed into the lagging. The piston is precision machined, ground, and lapped to a hollow cylinder closed at the upper end by means of a bronze piston head which also serves as the upper bearing. A torque plate is welded to the knuckle end of the piston, serving as a support for the brake mechanism.

A clevis is also screwed to the lower end of the cylinder to serve as a stop for the piston when it fully extended position. Below this clevis is the cylinder packing, the lower bearing and a reaction nut.

## REVENUE OF CONSTRUCTION

Representative of the best American practice in shock strut design, the P-38



5 Left: Major bearing near diameter shell—mainly in main strut on special fixture machine.



**6** Finish boring the cylinder chamber in main strut as in Ambros setup left.



**7** Thread million plates head and plug on a Lee Radnor thread mill



**8** Left: Heat treating department, which includes two electric furnaces, a quenching tank and work processing bed

**9** Below: Strut cylinders, pre-treated to 280 deg. F, by an Ames automatic electric furnace, are delivered through automatic ducts



that a spare conventional throughout its efficiency as a shock absorbing unit is the result of careful proportioning of the air and oil cylinders, and of the orifice between them, based on long experience and extensive testing. No one is a saint of the design more readily adaptable to quantity production, and more serviceable in the field, as compared with more complex parts, but it is also less susceptible to damage from gun fire or shell fragments. We know of no case of such a strut having been penetrated by an enemy shell or bullet. In fact, the hardened steel tube of the strut, made strong for its work as a structural member, is fully equivalent to the armor plate normally used to protect vital parts of an airplane. And the shape of the strut cylinder would not deflect any bullet or fragment that did not strike squarely. Finally, even if the strut were pierced, it would still function serviceably without air pressure.

#### HOW QUANTITY PRODUCTION IS ACHIEVED

In achieving quantity production on P-51 struts, the subcontractor has built and equipped a complete new factory designed specifically for this work. This plant is half again as large as the portion of the factory formerly devoted to engine manufacture. Furthermore, under the pressure for all-out strut production, we have converted a large part of the engine plant to strut work.

To illustrate the scope of the manufacturing processes involved, three follows a brief description of the operations performed on the main strut cylinder.

The upper end of the strut tube is finished by reaming to approximately half its original diameter. Then both ends of the tube are rough-bored to approximate length.

The cylinder O.D. is turned on a special Monarch engine lathe, equipped with a coneless glass attachment which controls the tool in cutting 12 different diameters, and feeds between them along the length of the cylinder. This machine performs both rough and finish cut operations. Rough cut for the upper where it shows 4 in. and the finished cut shows 4 1/2 in. The tube has a 22 in. throw and 72 in. bed. The cutter is set against the work by means of a rate follower held against the profile bar by an air cylinder. Following this, the upper end of the cylinder is drilled for location of oil and air filler plug.

Two tapered flanges are welded to the cylinder with a Lincoln arc welder. On the upper side of the cylinder is a ring flange with two sets of lugs, one extending forward which carries the lower end of the drag brace strut and the other extending laterally to the oil-head side to carry the side brace strut. This flange



**13** Milling both sides of legs simultaneously at one end of main strut with a Milwaukee duplex production mill.



**14** Finish drilling main cylinder with Carbide radial drilling machine.



**15** Left: Threading main cylinder on an Co-Co grinder.



**16** Right: Final dimensional inspection of main and nose strut cylinders

**17** Below: Main strut being given test in flexure press



is slipped over the cylinder and welded in place. The lower flange is a strap type, extending about halfway around the strut, and carrying legs for the attachment of the upper engine tube. This is welded in place while positioned in a precision jig. The air valve and fluid filler boss is also welded in place near the upper end of the cylinder.

Careful metallurgical control is exercised over the welding operation, maintaining constant check as the composition of the metal and welding rod heat of weld, etc. After tank welding, the cylinders are preheated to 300 deg. F in an automatic electric oven and then mounted in a power resisted welding jig which may be positioned to position (Page 6 Page 207)



**10** Left: Grinding a main cylinder on a Leland machine

**11** Lower Left: Finish boring holes in main and nose strut.

**12** Below: Grinding the packing gland chamber in the large end of main strut with Hestel cylinder.



## Timetable—for the OFFENSE!

CIVILIAN AMERICA is engaged in a desperate battle of production. There is no time for delay—no time for defensive tactics. We have no choice but to attack with every man, hour, with every machine, with every ounce of energy and resource that we can bring to bear in this vast offensive drive.

We can't talk 60,000 airplanes into the blue for '42. They must be built minute by minute, part by part, through thousands of man hours to final assembly. The job is big. Risks are high, and time is short.

To Goodyear Aircraft has been assigned the task

of producing thousands upon thousands of sub-assemblies vital to America's air defense. Our War Production Catalogue No. 1 might well read, "The President has set our goal. We must and will do better."

Goodyear's thirty years' experience in mechanical engineering, its facilities, resources, man power are dedicated to the strenuous production offensive. Nor do we differ in this from our brethren-at-arms of the aircraft industry. To them we pledge increased production of parts and sub-assemblies that America may be first in the air—with 60,000 military airplanes—this year!



## READY FOR THE FUTURE—NOW

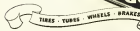
*Master mechanics building Goodyear airplane wheels in battle-line assembly*

PROPERLY designed wheel equipment—and that includes brakes, nuts and tubes as well as the wheels themselves—is more important than ever before on today's front, larger ships. Size, weight, strength and balance of this equipment are all major factors in modern airplane construction.

Goodyear produced the first complete airplane wheel-assembly thirty years ago and pioneered most of the improvements that are standard specifications today. The low-pressure Airwheel-type tire, the hydraulic disc brake, lightweight magnesium- and aluminum-alloy wheels and dual-tube tubes are all Goodyear developments.

As a result of long research continued through years when rewards were slight, Goodyear today is producing wheel-assemblies that exceed the needs of the most advanced aircraft yet proposed. Goodyear is ready now with proper wheel equipment for the giant super-aircraft just taking shape upon scores of drawing boards.

*Executive Department*  
THE GOODYEAR TIRE & RUBBER COMPANY



AMERICAN AIRCRAFT CO. INC. (Incorporated)  
The Goodyear Company



# Design Charts for Tubes Subjected to Bending

WHILE WORKING on the stress analysis of landing gear shock absorbers, the writer became impressed with the thought that something could be done to simplify the stress analysis of tubes subjected to bending. The idea of selecting a tentative size of compo-

sing its section modulus, an comparing it to fiber stress of determining its modulus of rupture and of comparing its margin of safety, came to have to repeat the entire process until a size was determined which yielded a small positive margin of safety, several engineers. A more direct approach was needed. For a given bending moment load, tube size and tube diameter, there is only one wall thickness that will yield a stress margin of safety. The method outlined below enables the engineer to determine the wall thickness, without calculating the section modulus or fiber stress and without determining the modulus of rupture. For any wall thickness other than that corresponding to zero margin of safety, one may readily determine the margin of safety or the stress ratio.<sup>1</sup>

As many engineers now carrying the aircraft field may not be familiar with the details of aircraft stress analysis, a brief discussion seems in order. The following terminology has been used:

- $D$  = Outside diameter of tube
- $d$  = Inside diameter of tube
- $P$  = Allowable bending stress (modulus of rupture)
- $S$  = Design bending stress =  $\frac{M}{Z}$
- $K_1$  = Constant for determining section modulus of tube. See Fig. 3 and "Eq. (1)"
- $K_2$  = Constant for determining section modulus of tube. See Fig. 3 and "Eq. (2)"
- $M$  = Bending moment for which tube is being designed
- $M'$  = Bending moment which tube is intended to sustain
- $M/S$  = Margin of safety
- $g$  = Pounds per square inch
- $R_1$  = Stress ratio =  $\frac{S}{P}$
- $t$  = Wall thickness
- $E$  = Section modulus

Represented in Fig. 1, is a family of curves for tabular and nomogram listing various load conditions. The bending modulus of rupture is given in a few lines of  $\frac{P}{E}$ . When  $\frac{P}{E}$  is equal to  $Z$ , the modulus is a solid bar.

From a glance at these curves it will



Walter C. Clayton

be seen that as the value of  $\frac{D}{t}$  gets smaller the allowable bending stress (modulus of rupture) increases. It may considerably exceed the ultimate tensile or compressive strength of the material. This increase results from the more remote fibers yielding and the adjacent fibers under the small load picking up more stress than would be the case if stress had remained proportional to strain.

As  $\frac{D}{t}$  gets larger and larger the wall thickness becomes relatively greater and wall modulus may appreciably reduce the allowable bending stress. Thus for large values of  $\frac{D}{t}$  the allowable bending stress may be appreciably less than the ultimate ultimate tensile or ultimate compressive stress.

The modulus of rupture is a fictitious fiber stress. It is the fiber stress that would exist, if at the instant of failure, stress had remained proportional to strain and wall modulus had played no part in the failure. It is a handy device that permits us to see how much stress is based on Hooke's law, for stresses beyond the proportional limit and far from where failure is due to local elastic instability.

The usual procedure in designing a tubular member to withstand a known bending moment is to select a size, a material and heat-treatment which

Design engineers will welcome this simplified method of determining wall thickness of tubes subject to bending to yield a desired margin of safety. This method eliminates the necessity for computing section modulus, fiber stress, and modulus of rupture.

By WALTER C. CLAYTON

Chief Engineer,  
Curtis Wright Technical Institute

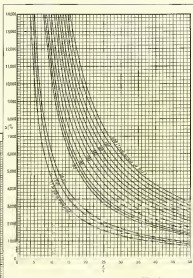
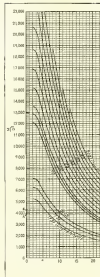


Fig. 4. Above Stress analysis chart for tubes with given inside diameter. This chart and Fig. 3 are obtained by multiplying the ordinates of the curves in Fig. 1 by three in Fig. 2.

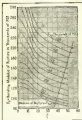


Fig. 1. Bending Modulus of Rupture—Chrome Molybdenum Steel Tubing



Fig. 2. Chart for determining the stress modulus of tubes of this or any diameter but of varying wall thicknesses.

<sup>1</sup>W. B. Blandy and E. J. Blandy, Stress Ratio—The origin is at Central London Technical Institute, June 1934.

would appear to be feasible. One may now compare the section modulus of the member, using either tables (where available) or the formula:

$$S = \frac{\pi}{32} \left( \frac{D^4 - d^4}{D} \right) \quad (1)$$

The required bending stress may be determined from the equation:

$$S = \frac{M}{\sigma} \quad (2)$$

Knowing the diameter and wall thickness of the tube, the numerical value of  $\frac{D^4 - d^4}{D}$  can be obtained. Referring to Fig. 1, the allowable bending modulus of rupture in thousands of pounds per square inch can be found. This is given as  $F_t$ . The margin of safety is

$$OS = \frac{F_t}{\sigma} - 1 \quad (3)$$

It must not be negative as this would indicate an unsafe structure. It must not be a large positive value as this would indicate a needlessly heavy structure. After obtaining the margin of safety, the designer must reconsider his original guess of the size of tube required. He may now select another tube to obtain a number of adequate strength but not excessive heavy. The trial and error, or guess and check procedure, is time consuming and frequently results in the selection of a number that is needlessly heavy.

For a given diameter tube it would be desirable to be able to compute directly the wall thickness necessary to give a zero margin of safety. Such a procedure is outlined in the following paragraphs.

The section modulus of similar tubes (where  $\frac{D}{d}$  is same as  $\frac{D'}{d'}$ ). The section modulus of tubes of the same diameter but having different wall thickness varies as a function of  $\frac{D}{d}$ . In place of "Eq. (1)" we may therefore write:

$$S = K_s D^3 \quad (4)$$

The variation of  $K_s$  with  $\frac{D}{d}$  is represented by the lower curve of Fig. 2. If desired, the section modulus can be computed using the inside diameter. This at times is convenient. The formula then becomes:

$$S = K_s' D'^3 \quad (5)$$

The value of  $K_s$  can be obtained from the upper curve of Fig. 2.

Both  $K_s$  and  $K_s'$  are also functions of  $\frac{D}{d}$ . This suggests that the curves of Fig. 3 and of Fig. 4 might be combined with a means of selecting a zero stress design procedure in determining the size of tube desired. Actually, by multiplying the ordinates of the curves in Fig.

1 by the ordinates of the curves in Fig. 2 the curves of Figs. 3 and 4 are obtained. The ordinates in Fig. 3 represent pounds per square inch of stress which can be supported. Using  $\frac{M}{S} = \frac{M}{\frac{\pi}{32} \left( \frac{D^4 - d^4}{D} \right)}$ . The ordinates in Fig. 2 represent a dimensionless constant. The product in the ordinates of Figs. 1 and 2 is  $\frac{M}{K_s D^3 (K_s')} = \frac{M}{S}$  which is placed against  $\frac{D}{d}$  for the various heat-treated steels. Provided that the tube is of reasonable proportions,  $\frac{M}{S}$  will have a numerical value of between 1,000 and 20,000. The results of using Fig. 3 are identical to those of using Fig. 1, but much more exact.

The use of the curves can best be illustrated by example.

#### Example

Given: A piston tube of a combustion engine having zero shock absorber having a bending moment of 250,000 in.-lb. It is desired to make this tube 4 inches in diameter and in order to keep the weight down the tube will be heat treated to 160,000 psi ultimate tensile stress.

Wanted: (a) The required wall thickness for zero margin of safety.

(b) The margin of safety and the stress ratio, assuming that it is desired to make the wall thickness 0.125 in.

$$\text{Solution:} \\ (a) \frac{M}{S} = \frac{250,000}{S} = 3,125$$

This point is designated as A on the  $\frac{M}{S}$  scale of Fig. 3. Draw a horizontal line and extend it until it intersects the 160,000 psi curve in B. Drop a vertical line from B to the  $\frac{D}{d}$  scale at C. The value of  $\frac{D}{d}$  for point C is 35.7.

The required wall thickness for zero margin of safety is  $\left( \frac{D}{d} \right) = \frac{4}{35.7} = 0.112$ "

(b) For a wall thickness of 0.125 in the value of  $\frac{D}{d} = \frac{4}{0.125} = 32$ . This is point D on the  $\frac{D}{d}$  scale. Draw a vertical line up to point E on the 160,000 psi curve. From E draw a horizontal line to F on the  $\frac{M}{S}$  scale. Point F represents the value of  $\frac{M}{S}$ , where  $M$  is the bending moment that can be resisted when the wall thickness is 0.125 in. Its value is 4,716.

The margin of safety is determined as follows:

$$(M.S.) = \left( \frac{\frac{M}{S}}{\frac{M}{S_{\text{actual}}}} \right) - 1 = \frac{4,716}{3,125} - 1 = 0.507 = 50.7\%$$

When the problem involves stress ratios the stress ratio,  $K_s = \frac{F_t}{\sigma}$ , may be expressed as  $K_s = \frac{3,125}{4,716} = 0.663$

By considering similar members of relatively large diameter and then wall which are machined made and so on, the matter of manufacturing tolerances should be given careful consideration.

The specified tolerances for standard tubing stress against standard members. The designer must stress against standard machined tubes. In an instance in the case above, due to the inside diameter as to be held in tolerance of  $\pm 0.001$ " and that the inside diameter  $\pm 0.001$ "

is to be held to  $\pm 0.010$ " or, it is readily seen that the wall thickness could be 0.015 in. less than the standard thickness. To insure against a negative margin of safety the nominal wall thickness would have to be  $0.125 + 0.015 = 0.140$ ". Similarly if a margin of safety of 7.7 percent or a stress ratio of 0.929 is desired, the nominal wall thickness should be  $0.125 + 0.023 = 0.148$ ".

It frequently becomes necessary, as in the case of a shock absorber cylinder, to maintain the bore of the cylinder and make the inside diameter that which is necessary to insure adequate strength. In this case we are concerned with  $d$ , the inside diameter instead of  $D$ , the outside diameter. We may proceed a similar set of curves to those shown in Fig. 3 in which  $\frac{D}{d}$  is plotted against  $\frac{M}{S}$ .

This can be used in exactly the same manner as that illustrated above. Such a set of curves are contained in Fig. 4.

#### Example

Given: A cylinder with a bending moment  $M = 250,000$  in.-lb. made of alloy steel, heat-treated to 160,000 psi and having an inside diameter equal to 4 in.

Wanted: The required wall thickness for zero margin of safety.

Solution:  $\frac{M}{S} = \frac{250,000}{S} = 3,125$

From Fig. 4 the value of  $\frac{d}{D}$  is 32.8. Therefore the required  $d$  for zero margin of safety is equal to  $\frac{4}{32.8} = 0.122$ ".

The outside diameter would be  $4 + 2(0.122) = 4.244$ ". (Data to page 29)



## WHAT MAKES GOOD AIRCRAFT WIRE?



### 1—SPECIALIZED MATERIALS

Aircraft wires are engineered for survival from the ground up. Not "just copper," but electrically pure copper. Not "just steel," but purified, long single crystals. Not "just rubber," or "just lacquer," or other composite materials. Every ingredient is specially selected—tested—proved best.

### 2—SPECIALIZED WORKMANSHIP

Highly developed machines geared to give their utmost in quality and speed for defense production. Skilled craftsmen—mastering supervision—constant attention to detail—meticulous uniformity in every foot of finished product.

### 3—SPECIALIZED EXPERIENCE

Bank of Belden counts why it is a lifetime of working, experimenting, service testing. Belden has collaborated with several major aircraft design groups over the years. The vast experience and technical knowledge make possible the Belden wire that meets today's needs.

# Belden

## Aircraft WIRE

Starter, Lighting, and Instrument Cables • • • SPARK PLUG WIRES



## EVER FEEL A WING AT THIRTY THOUSAND?

You know that the metal is pretty darned cold at that altitude, down to  $-34^{\circ}$  or less by actual test.

And yet, all in the space of a few minutes that plane might be coming down—stain to put in at a field where they hate the thermometer because it's so hot.

Just a common every-day occurrence in modern aviation—and plane performance is

taken for granted. Among other things, an aviator expects the ability of the finish to stand up and stay smooth under the stress and strains of continually vibrating, contracting, expanding metal.

Under any conditions, Valspar Val-Aero Aircraft Finishes do the job they're built for—and do it well... on any part of a plane.



A complete line of dependable Aircraft Finishes — that meet government specifications in every respect

VALENTINE & COMPANY, INC. • 11 EAST 34<sup>TH</sup> STREET, NEW YORK, N. Y.  
ESTABLISHED 1923

MAKERS OF THE FAMOUS VALSPAR FINISHES



## Cleaning Alclad For Production

Mass production spotwelding is advanced by a new method for cleaning Alclad parts.

By FRED MORRIS, Engineering Department, Flotwings, Inc.

VERSATILE is a good word to use when speaking of Flotwings' production and design. A review of the contrasts underway shows that three types of construction are being used: spotwelded stainless steel, riveted aluminum alloy, and spotwelded Alclad. About 30 percent of the spotwelding being done is on aluminum alloy parts for control surfaces.

All of the Flotwings developments in Alclad spotwelding have been accomplished since Navy approval of Flotwings' equipment was received in 1946 with a report commending the consistency of the welds which showed a maximum deviation in strength of only 8.3 percent. Since that time many methods have been developed to help Flotwings to maintain its exact delivery of an exact control surface.

### METHOD OF PREPARING SURFACE

One phase of the problem of production spotwelding of Alclad involved the development of a method of preparing the surfaces of the metal to secure a satisfactorily low surface resistance be-



In Flotwings' cleaning operation, parts to be dipped are placed in a long basket suspended from overhead traveling crane running on the glider tracks. In this manner, basket and contents can be transferred easily from one tank to another.



The basket, into which the parts to be cleaned are put, is made of stainless steel so that it will resist the alkali used hard in the process.

tween the parts to be welded, and to do it consistently. A satisfactory method was developed and a number of improvements have been furnished the client in the past few months. The details are not down here for others who may find them useful in the furthering of our national defense.

Where quantities are small, the old reliable method of preparing the surface with a rotating wire brush is suitable. However, such a method is too slow, and requires too much manpower for today's requirements, and involves the human element which results in variable degrees of cleaning. Therefore, chemical cleaning processes were investigated to speed up output of parts for spotwelding. Some chemical processes did not give consistently good

(Turn to page 202)



**The  
Score at  
LOVE FIELD  
DALLAS**

## 40 Flights ... 40 Planes have fluids

There is a daily average of 40 flights by these airlines at Love Field, Dallas— headquarters for Braniff Airways, based at the American Airlines and Delta Airlines. 100% of these planes have installations of Cuno Filters.

**Y**OU engine and aircraft builders have real faith in the Cuno Filter. You must feel that it is the most dependable means of keeping fluids clean—at high speeds, at high altitudes, for long periods of time.

For you have been practically unanimous in your choice of Cuno. Cuno was in on the ground floor of aircraft engine lubrication. Engine builders recognized it as an

opportunity to insure further against failure due to contaminated fluid or clogged fluid lines. And in the succeeding years, Cuno engineers have satisfied many other aviation requirements.\* Today, the demands of engine and aircraft builders are largely responsible for the tripling of Cuno's manufacturing facilities.

\* Among them the Cuno withdrawing filter. See illustration at right.

### From Drafting Room to Maintenance Shop

The Cuno engineer serves the industry in many ways—designing filters for individual applications—aiding aviation designers in building Cuno Filters into their blueprints—serving the ultimate operators of the aircraft.

That is why Cuno engineers are familiar figures in drafting rooms, near assembly lines, on proving grounds, in airport maintenance shops.

If your responsibility is the protection of lubricated or fluid controlled parts, the selection of a Cuno Filter will be in line with the entire industry's best judgment.

## protected by CUNO FILTRATION



### Completely Automatic Filtration

Cuno's self-cleaning filter was developed with the assistance of prominent aviation engineers. A tiny hydraulic motor, powered by the oil it helps to keep clean, rotates the filter element continuously past cleaner blades which passively catch out suspended as well as adherent solids. Fluid systems equipped with Cuno's self-cleaning filter are kept free of sludge and combustible solids, at all times and with minimal cleaning out of the pump the only attention required.

KEEP FLOW ON "GO" WITH

**CUNO**

THE "FILTER-FINE" STRAINER

**Cuno  
Engineering Corporation**  
704 South Vine Street  
Meriden, Connecticut

# Salvaging Power In Engine Testing

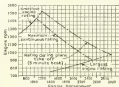


Fig. 3. Typical curves showing range of engine horsepower and speeds for which testing equipment should be designed.

**WASTE AND DISREGARD** of value in industrial processes, even though sometimes extremely necessary, will sooner or later be eliminated by a progressive management.

What is it that a large airplane engine manufacturer not long ago said, in substance, "Our present methods of testing are not satisfactory. Current systems of testing are devised which will be economically efficient and which will make the loading of large engines easy and simple?"

He continued: "Engine testing is a very important part of airplane engine manufacture. Each engine must be run under load for considerable periods. Usually whenever one loads for production loading of engines, are subjected gas pollution, water breakers, electric breakers, and similar devices, all of which involve disposal of the engine power by complete waste. The lost consumed, although small, complicates an useful purpose other than to permit testing the engine. Furthermore, engines are proving to be in use to the extent that the present power dissipating schemes of testing are beginning to present some difficult problems."

The following system of testing was developed in answer to the foregoing query. Since the first modification of this character, consisting of two testing runs, recently five additional units have been or are in the process of being installed. Some of these additional units differ in detail but they all involve the same problems and the same scheme of operation described in this article.

To arrive at the required answer, there are three logical steps of thought: (1) determination of the characteristics

of the engine to be tested; (2) determination of a means of utilizing the power generated by the engine while being tested; and (3) determination of a system which will be (1) and (2) together.

(1) Involving general manufacturing test data, the testing system will be most useful if it can accommodate a range of engine sizes. In order to be specific, assume that it is required to test engines designed for the operating ranges shown in Fig. 3—that is, to test an engine within the range indicated as the largest and the smallest engine. (2) Involving general manufacturing test data, the testing system will be most useful if it can accommodate a range of engine sizes. In order to be specific, assume that it is required to test engines designed for the operating ranges shown in Fig. 3—that is, to test an engine within the range indicated as the largest and the smallest engine. (3) Involving general manufacturing test data, the testing system will be most useful if it can accommodate a range of engine sizes. In order to be specific, assume that it is required to test engines designed for the operating ranges shown in Fig. 3—that is, to test an engine within the range indicated as the largest and the smallest engine.

(3) Involving general manufacturing test data, the testing system will be most useful if it can accommodate a range of engine sizes. In order to be specific, assume that it is required to test engines designed for the operating ranges shown in Fig. 3—that is, to test an engine within the range indicated as the largest and the smallest engine. (3) Involving general manufacturing test data, the testing system will be most useful if it can accommodate a range of engine sizes. In order to be specific, assume that it is required to test engines designed for the operating ranges shown in Fig. 3—that is, to test an engine within the range indicated as the largest and the smallest engine.

hourly operation between the power company involved and the engine manufacturer.

(2) Passing to the third consideration, that of tying the engine and the power system together, it will be seen that the problem is essentially that indicated in the title of this article—namely, the problem of tying together a constant-frequency power system and the operation of a varying-frequency power system.

There are a number of ways of attacking the problem. For example, the engine might be connected to a dc



Fig. 4. Graph showing that of the total of 4222 hp-hr delivered by an engine during a test run, 4427 hp-hr, were recovered in the generator.

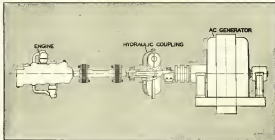


Fig. 5. Schematic view of the recuperative test stand, which enables a drive at varying speed to pump power into a constant-frequency system.

machine and the machine connected to the power system through an adjustable voltage drive. Work-tested principles involving induction machines might be resorted to. A synchronous machine with rotating rotor as well as rotor is feasible.

But none of these possible drives will compare favorably, with the drive illustrated in Fig. 2 which drive consists of a conventional synchronous machine and directly to the power system, together with a slip coupling (a hydraulic coupling is the illustration) interposed between the engine and the synchronous machine.

In the operation of this equipment, the synchronous machine may run at a motor or as a generator. With the coupling disconnected, the synchronous machine is brought to speed and synchronized in the same manner as a conventional synchronous motor. Thereafter, the coupling is engaged to enable the synchronous machine "take over" the engine. The engine is fired and after it is warmed up it is brought to a speed above that of the synchronous machine. This machine, then acting as a generator, is loaded back on the power system by slipping of the coupling. The amount of this load is controlled by the engine throttle and the degree to which the coupling is engaged.

To illustrate the distribution of engine power, assume that the synchronous machine has a constant speed of 750 rpm and that the largest engine shown in Fig. 3 is to be tested at speeds of 750 rpm, 900 rpm, and 975 rpm. Then, neglecting machine efficiency, which will not affect the general picture, the power

distribution is as follows:

Engine Speed	Rp	Coupling Slip (%)	Generator Output (hp)
750	1800	71	1270
900	1800	50	1350
975	1800	46	1420

\* Approximately proportional to engine speed.

Thus at 800-hp output as the engine all of the 4200 hp is not lost, as was the case with a dc form of the load dissipating unit. Only 580 hp is lost. The bulk of the power 2300 hp, is made available for useful purposes by the generator.

Some variations of this fundamental scheme of testing can be employed. For example, it will be noted that the generator will act as a load on the engine only when driven above synchronous speed. It is as desired to load the engine below synchronous speed, this can be done by the absorption capacity of the coupling by holding the rotor of the synchronous machine stationary—see, for example, the success of a breaker. Fig. 3 illustrates a test run of a typical medium-sized airplane engine under such conditions, using a 300-hp generator.

At low engine speeds, the horsepower delivered by the engine is relatively low so that the coupling will not be called upon to dissipate more horsepower than it will be required under maximum running conditions. At low speeds, also, the duration of the test run is short so that the horsepower-hour loss in the coupling are a relatively low proportion of the total.

The foregoing application when viewed in the abstract presents several

points that are of interest to those who have to do with new and better ways of doing things. In the first place, the fact that this new method of testing was brought into being was the result of an endeavor by a few persons who had the vision and initiative necessary to break new, from well established practice and to delve into the field as experimenters.

## GENERAL CONCLUSIONS

Again this development is typical of many such developments in that it brought about greater engine costs that was originally sought. In this instance, the main objective was economy. This objective was attained but in addition a more effective way of testing large engines was also developed.

Another typical point is that the system, although relatively simple, as exemplified in Fig. 2, was not at first perfect and was arrived at only by laborious considering and possible scheme of drive after another. In the scheme shown in Fig. 2, the hydraulic coupling was adapted for the first time in a new role. Previously it had been used either at low slip values or as drive with rapidly decreasing power with increase in slip, such as the driven in the engine-loading application will be noted that power increases, and increases rapidly, with increase in coupling slip.

Lastly, the application reveals that it is sometimes quite as difficult to dispose of power as it is to generate power.

## A composite image. On the left, a model of a rocket engine is shown above a circular plate with a four-pointed star-shaped hole. On the right, a close-up shows a hand holding a spark plug, with a label '1-3' visible at the bottom right.

## THE LAST TURN - MORE

A big advantage of the Philips reversed hand screw principle is the greater high-torque power afforded by the increased contact between driver and screw. It is proved that the two components are strong enough to resist bending.

**Philips Reversed Hand Screw Machine Handling Power with Strength**

Before the Philips Reversed Hand screw appeared on the market, hundreds of years had been made to determine exactly the shape, depth and type of reverse which would give increased turning efficiency without danger of splitting the screw head or bending the bit. Actual performance on many swivel and intermediate assembly lines has now confirmed our engineers' conclusions.

Now, over 200 forwarding experts, backed up by the 25 manufacturers of Philips Reverses, are in the field to help you with your turning problems and to suggest ways of further increasing the savings in time and dollars through the use of Philips Reversed Hand Products.

In the average case, Philips Reverses cut 25% loss to cost. That's why the amount of bending, twisting and





Now, over 268 fastening experts, headed up by the 25 manufacturers of Phillips Screws, are in the field to help you with your fastening problems and to suggest ways of further increasing the savings in time and dollars through the use of Phillips Recommended Head Products.

In the average case, Phillips Screws cost 50% less to use. That's why the majority of leading aviation and automotive manufacturers use Phillips.

Specify Phillips and Save 50%

**PHILLIPS** RECESSED  
HEAD SCREWS

NIGHT DINING • MULTIPLE DINING • FIRST RATE SERVICE • FINEST WINE  
 SPECIAL PROGRAM DURING HOURS • SEATING WITH LOVE GUARANTEED

## 19 SOURCES OF SUPPLY

[illegible]

Fig. 3 Chart to find reduction factor in A1913 type steel rods and steel bolts for stress larger than 75 ksi, diameter.

TABLE II.—*M* Standard Hex-Nut and Circle Bolts and Flange[illegible]

Note: These strengths are based on wires of steel at full diameter. Tensile strength is based on area of strand at end of service.

Senior Stress Analyst, Consolidated Aircraft Corporation

be used in any one of them, depending on what secondary requirements are to be fulfilled.

only with joints which are subjected to forces which produce shear loads on the rivets and bolts.

The strength of a riveted or bolted joint can be determined by reasonably accurate methods of analysis. For explanation, riveted joints only are considered, although the same methods of analysis are also applicable to bolted joints. Such analysis may be used to find the total strength of the joint, though it is more practical in many cases to determine the load on the most highly loaded rivet as the result of a given loading, and then compare this

TABLE 1.—(AISC-51)—Bearing Strength of Steel Bolts, Nuts, and Plates.

Material	240 metric tons	240 metric tons	240 metric tons
Female strength (lb. per sq. in.)	33,000	220,000	180,000

1990-1991	20,000	40,000	70,000
-----------	--------	--------	--------

Year	Water supply (m <sup>3</sup> )	Water supply (m <sup>3</sup> )	Water supply (m <sup>3</sup> )
1974	100	100	100
1975	100	100	100
1976	100	100	100
1977	100	100	100
1978	100	100	100
1979	100	100	100
1980	100	100	100
1981	100	100	100
1982	100	100	100
1983	100	100	100
1984	100	100	100
1985	100	100	100
1986	100	100	100
1987	100	100	100
1988	100	100	100
1989	100	100	100
1990	100	100	100
1991	100	100	100
1992	100	100	100
1993	100	100	100
1994	100	100	100
1995	100	100	100
1996	100	100	100
1997	100	100	100
1998	100	100	100
1999	100	100	100
2000	100	100	100
2001	100	100	100
2002	100	100	100
2003	100	100	100
2004	100	100	100
2005	100	100	100
2006	100	100	100
2007	100	100	100
2008	100	100	100
2009	100	100	100
2010	100	100	100
2011	100	100	100
2012	100	100	100
2013	100	100	100
2014	100	100	100
2015	100	100	100
2016	100	100	100
2017	100	100	100
2018	100	100	100
2019	100	100	100
2020	100	100	100

<sup>10</sup>Other policy issues in the extreme right-wing column, from left to right, include: (a) the role of the state; (b) the environment; (c) the economy; and (d) the family.

TABLE III.—Allowable Shearing Strength of 2024 Alclad Aluminum Alloy Sheet (14.3) (Riv = 91,000 psi)

Size of Bolt or Pin (in.)	AN	AN	AN	AN	AN	AN	AN	AN
1/8	11	100	143	210	289	380	498	630
3/16	19	138	194	289	391	509	657	827
1/4	27	194	279	414	554	719	919	1154
5/16	35	250	359	539	719	939	1219	1534
3/8	43	306	439	654	874	1154	1474	1854
7/16	51	362	519	774	1034	1354	1734	2174
1/2	59	418	599	884	1184	1554	1974	2454
5/8	67	474	679	1004	1334	1754	2234	2774
3/4	75	530	759	1124	1484	1954	2474	3054
7/8	83	586	839	1244	1644	2154	2734	3374
1	91	642	919	1364	1804	2354	2974	3674
1 1/8	99	698	999	1484	1964	2554	3234	3974
1 1/4	107	754	1079	1604	2104	2754	3474	4274
1 3/8	115	810	1159	1724	2244	2954	3674	4574
1 1/2	123	866	1239	1844	2384	3154	3934	4874
1 3/4	131	922	1319	1964	2524	3354	4174	5174
1 7/8	139	978	1399	2084	2664	3554	4374	5474
2	147	1034	1479	2204	2804	3754	4574	5674

TABLE III.—Shear and Bearing Strength of Aluminum Alloy Rivets and Bolts

Size of Rivet or Bolt (in.)	AN	AN	AN	AN	AN	AN	AN	AN
1/8	11	100	143	210	289	380	498	630
3/16	19	138	194	289	391	509	657	827
1/4	27	194	279	414	554	719	919	1154
5/16	35	250	359	539	719	939	1219	1534
3/8	43	306	439	654	874	1154	1474	1854
7/16	51	362	519	774	1034	1354	1734	2174
1/2	59	418	599	884	1184	1554	1974	2454
5/8	67	474	679	1004	1334	1754	2234	2774
3/4	75	530	759	1124	1484	1954	2474	3054
7/8	83	586	839	1244	1644	2154	2734	3374
1	91	642	919	1364	1804	2354	2974	3674
1 1/8	99	698	999	1484	1964	2554	3234	3974
1 1/4	107	754	1079	1604	2104	2754	3474	4274
1 3/8	115	810	1159	1724	2244	2954	3674	4574
1 1/2	123	866	1239	1844	2384	3154	3934	4874
1 3/4	131	922	1319	1964	2524	3354	4174	5174
1 7/8	139	978	1399	2084	2664	3554	4374	5474
2	147	1034	1479	2204	2804	3754	4574	5674



AN Bolt Head



AN Bolt Head



AN Bolt Head

Fig. 3. Characteristic markings placed on the head of each bolt make for easy identification.



Fig. 4. A top joint is formed when the plates or sheets fit in by being riveted together with other and are formed by use of nuts and bolts.



Fig. 5. In a butt joint, split plates are riveted to the sheets to be split and which are placed with their edges in the same plane.



Fig. 2. Rivet head markings used to indicate composition of rivet material.

augmented load with the allowable strength of the metal. Note that the rivet heads and allowable loads are used throughout rather than the integrated stresses and allowable stresses. As a result, all mechanical computations are considerably simplified. The allowable loads on all standard rivets and bolts used in aircraft structures can be quickly obtained from tables; for example, Table I and Table III, ANCS-5, strength of Aircraft Elements. Portions of these tables are included.

Table I gives the allowable single shear strength of all tests of steel wires, steel machine screws and steel bolts that are commonly used in aircraft construction. An additional Table II has been included to show the shear and tensile strengths of AN standard head and close head bolts made from aluminum alloy as well as steel. The shear strength of AN steel close head bolts is also shown. AN standard parts are those approved by both the Army and the Navy.

AN steel type steel nuts for AN steel bolts (120,000 lb. per sq. in. test strength) for sizes larger than 1/2 in. diameter will not develop the full tensile strength of the bolts. The preceding chart (Fig. 1), may be used to find the reduction factor to be used in such cases. To develop the full tensile strength of AN bolts larger than 1/2 in. diameter it is necessary to use either additional pairs of special nuts with a longer grip. For



Fig. 4. Symbols denoting diameter of rivets used by the Consolidated Aircraft Corp.



Fig. 5. Diagram illustrating the pitch of rivets used in double rows.

bolts less than 1/2 in. diameter the rivet strengths given in the table may be used.

The terms machine screws and bolts should not be used interchangeably as they are not identical components. All steel aircraft bolts are made from high tensile strength steel, whereas machine screws in many cases are made from metals which have superior machining properties but lower strength qualities. All bolts listed in the column headed under strength steel, whereas machine screws in many cases are made from metals which have superior machining properties but lower strength qualities. All bolts listed in the column headed under strength steel, beginning with size No. 10-32, are AN steel bolts. These can be identified on sight by characteristic markings placed on the head of each bolt as shown by the diagrams in Fig. 2.

Furthermore, all aircraft bolts, with the exception of rivet-head bolts, have rounded (hemispherical) heads. In one of these two ways, an aircraft bolt can always be recognized from machine screws which are left unrounded. Aluminum alloy bolts of 2024 material are identified by two markings on the head of each bolt as shown above. Aluminum alloy bolts of 5057 material are marked for design and procurement.

The use of machine screws is not allowed in the primary structure of the airplane, nor on the attachment of superstructure and accessories, where failure would be of serious consequence. Primary structure may be defined as the



## Gangplank TO THE AIR AGE

Aircraft engines are moving the world into the Air Age. Around powerplants now on the way will be built the giant transports of tomorrow 'Flying daycoaches', with the comfort of air travel, will cut time and distance for everyone. Wright's unsurpassed research and production facilities will supply the power for these sky-giants of the future.

**WRIGHT** Aircraft Engines.



View of Curtiss P-40B in flight from Self-Locking Nut.

## HOW BOOTS NUTS HELP CURTISS "Keep 'Em Flying"

Keeping planes in the air is what counts today. Frequent repairs mean hours lost on the ground—and consequently a less efficient fighting power.

To help men easily repair hours on every check-over, Curtiss uses Boots Self-Locking Nuts. These longer lived fasteners reduce maintenance time because they need not be replaced. They are permanent—durable, they "outlast the plane."

In addition, Curtiss induces weight as an asset

Cargo ship, the C-46... and in one application, saves two precious assembly hours per panel plane because these Self-Locking Nuts, being all-metal, can withstand the extreme heat necessary to bake the enamel on the tail surfaces of the famous Curtiss P-40.

*The Boots (arrow) Nut is the only all-metal, one-piece self-locking nut to pass the rigid tests of the Army, Navy, and Civil Aeronautics Authority*

Self-Locking Nuts for



application in all industries

Customs of Boots Anchor Nut with threaded steel bolts

# BOOTS

AIRCRAFT NUT CORPORATION  
NEW CANAAN, CONNECTICUT

structural members, necessary to resist flight and landing loads imposed on the airplane itself.

The shear strength of aluminum alloy rivets and the bearing strength of 24ST Alclad aluminum alloy sheet can be obtained by reference to Table III, ANC 3, Strength of Aircraft Elements. The first part of this table, given for allowable single shear strength of all sizes of rivets that are commonly used in aircraft construction. The portion of the table may be assumed to apply to rivets either with or without countersunk heads.

The Table IIIa, gives the allowable bearing strength of aluminum alloy sheet. The portion of this table applying to 24ST Alclad is shown. These values apply specifically to rivets which do not have countersunk heads. However, they are conservatively assumed to apply to rivets with any type of head, although this is unsafe for certain combinations of rivet diameters and sheet thicknesses.

AN standard aluminum and aluminum alloy rivets are made in four forms identified by the standard AN 425 (78 degree countersunk head), AN 430 (round head), AN 442 (flat head), and AN 435 (bracket head).

The four AN rivet types are available in four different materials: Type A—Aluminum rivets. No heat treatment, low strength. Type AD—Aluminum alloy (annealed 17ST). Faceted lead-in head and driven as removed. Moderate strength.  $F_u = 20,000$ ; Type D—Aluminum alloy (24ST). Heat treatment required before using.  $F_u = 30,000$ ; and Type DD—Aluminum alloy (24ST). Heat treatment required before using.  $F_u = 30,000$ .

The particular aluminum alloy from which a rivet is made is indicated on the rivet by characteristic markings placed on the head of each rivet. The rivet head to which this marking is applied is called the factory or manufacturer's head. The head bearing where the rivet is installed is referred to as the driven or finished head. The rivet head markings used to indicate the composition of the rivet material are shown in Fig. 2. Rivets made from pure aluminum have no characteristic marking on the head.

Rivet sizes may be indicated on a drawing by symbols which denote the diameter as shown by the diagram in Fig. 4. These particular symbols have been adopted as standard by the Consolidated Aircraft Corporation.

### DEFINITIONS AND PRINCIPLES

Riveted joints are divided into two general groups which are classified as Lap joints and Butt joints. When the plates or sheets to be joined by riveting

overlap each other and are held together by one or more rivets, a lap joint is formed (See Fig. 1). In a butt joint, Fig. 6, the plates or sheets are placed with the edges to be joined in the same plane, and splice plates are added either on one side or on both sides of the sheets to be joined. The splice plates are riveted in the sheets which are to be spliced, with each rivet extending through the plates and one of the sheets of the joint.

Rivets may be used in one or more rows. Single rowing is one row of rivets in a lap joint or one row on each side of a butt joint. Double rowing means two rows of rivets in a lap joint or two rows on each side of the joint in a butt joint. Rivets are usually spaced at equal distances along these rows, called the gage line. The distance between rivet centers is called the pitch of the rivets. The distance between gage lines is called the transverse spacing or lateral pitch. Disposal pitch refers to the distance from the center of the rivet in one row to the center of the nearest rivet in an adjacent row when the spacing of the rivets in the rows are staggered (See Fig. 7).

The simplest form of riveted connection is analysis, a lap joint in which the two plates overlap each other and are connected together by a single rivet, as in Fig. 8. The plates are assumed to be of equal thickness. It is more common to determine the load which the joint can carry from its analysis the stress resulting from a given load.



Fig. 8. A lap joint in the simplest form of riveted connection is analysis.



Fig. 9. In a butt joint the bearing strength of the rivet varies directly as the thickness of the lap.

Failure of the joint may occur in any one or a combination of two or more of the following ways:

### SHEARING OF RIVET SHAFT

As the intersection of the rivet in the plane between the two plates, the rivet may shear, or transverse stress to the other by means of shear in the rivet. The shearing stress on the rivet is assumed to be uniformly distributed over the cross-section. For any rivet in shear, the strength of the rivet or the load at which failure will occur is:

Shear Strength of Rivet  $P_s = A_s \times S_s$

Where,  $P_s$  = ultimate allowable shear stress of the rivet in shear, which the rivet is made ( $lb/in^2$ ).

$A_s$  = cross-sectional area of the shaft of the rivet. Most rivets have round shafts for which the area is:

$$A_s = \frac{\pi}{4} d^2 = \pi \left( \frac{d}{4} \right)^2 = \frac{\pi d^2}{16}$$

It is important to note a design warning to observe that the shear area and consequently the shear strength of a rivet varies as the square of its diameter. Thus, doubling the diameter of the rivet shaft quadruples its strength by four.

$N$  = Number of plates along which the rivet tends to shear. Rivets having one such plate are said to be in single shear. Two such plates are referred to as double shear, etc. For design purposes, the load required to shear a rivet may be assumed to increase directly as the number of plates against which shear occurs, so that in double shear a rivet is twice as strong as in single shear. The allowable ultimate load in single shear for all sizes of aluminum alloy rivets that are commonly used in aircraft construction are tabulated in bulletin ANC-3, Strength of Aircraft Elements, from which Table III was taken. Consequently the shear strength of these rivets can be obtained without computation.

### STRENGTH OF THE SHEET

The strength of the sheet in this aspect is sometimes assumed to be the shear strength of the two areas between the center line of the rivet hole and the edge of the sheet. This criterion, from the Centerline of the rivet hole to the edge of the sheet, is termed the edge distance (See inside diagram).

The shear strength of the sheet obtained by using the edge distance is somewhat in excess. The failure of the sheet will be along the line of minimum area which would be somewhat less than the distance to the center-



line at the 1994 Transamerica, the failure of the -box will most likely be a combination of them along one of the lines after which the sheet is way off the mark is best so that the rest is allowed to pass.

A more reasonable value for the strength of the sheet in shear is obtained by assuming that the sheet shears along two areas between the edge of the rivet hole and the edge of the sheet. This distance, from the edge of the rivet hole to the edge of the sheet, is termed the *shear distance* (Johnson, 1955).

The use of the near-axis distance is equivalent to the assumption that the vessel is square and has the same dimensions for any side as the diameter of the arterial vessel.

The shear strength of the sheet, or the load at which failure will occur is...

Where  $F_u$  = ultimate allowable shear stress of the metal from which the sheet is made (lb./sq. in.)

$A_c$  = Cross-sectional area of the sheet along which the sheet tends to shear =  $F \times$  true cut distance  $\times$  thickness of sheet  
 $t$  = Thickness of sheet

There are two areas along which the steel tends to shear. The equation for tear-out strength is therefore:

Tear-out strength of sheet in  
 $T \times F_s \times TQ \times t$

An equation equivalent to this but differently expressed is given in Bulletin ANC-5 for determining the allowable shearing strength in the eye of a tie rod, Fig. 9, as follows:

where

$P_4$  = Allowable shearing strength in the eye or leg in lb

$R$  = Outside radius of eye  
 $D$  = Diameter of pin  
 $t$  = Thickness of lens

$F_u$  = Ultimate allowable shear stress of the metal from which the lap

It should be observed from the two

formulas given above that the tear-out strength of a joint varies directly as the thickness of the sheet,  $t$ , and the

If the thickness is large, the theoretically measured true-net distance is very small.

Such small tear-out distances may not be sufficient to prevent bulging of the

short when the rivet is driven, thus causing a weakened and unsightly joint.

In such cases, the rivet must be either under-driven or a bolt substituted for the rivet. In some cases it is possible

to pack up the edge of the sheet during the drawing process. Brazilian workers

can also be obtained by inserting the perforated head on the side of the joint

Experience has shown that if an edge-

distance measured in terms of the di-

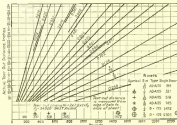


Fig. 10. Curves depicting the tear-out strength of oil standard papers of ENST Alclad sheet.

ability of the rivets of those over and under the two diameters is maintained because the combination of the rivet and the edge of the sheet, the joint will not fail by tearing out. For this reason it is not necessary to calculate the bearing strength of joints, which satisfy the edge distance requirements. However, all joints which do not appear to have sufficient edge distance should be checked for strength. The design purposes of a curve at the strength of all standard grades of 2487 Alclad sheet for any given over-pot distance has been investigated and concluded to be to be as substantially profitable. (See Fig. 10.)

#### CRUISING OF SHEET FEELING ON FEET

At one side of the rivet hole is one sheet and on the opposite side of the rivet hole is the other sheet the load is transmitted between the sheet and the rivet in compression, as is shown in Fig. 1. It is usually stated as bearing.

On account of the cylindrical surface of the rivet and the rivet hole, the resulting stress is variable in both direction and intensity. However, for the purpose of determining the strength of the joint, the bearing stress is assumed to be uniform. As a result, the bearing strength of the sheet, as the load at which failure will occur, is

Bearing strength of sheet =  $F_{tu} \times A_{nt}$   
Where

$F_u$  = Ultimate allowable bearing stress of the metal from which the plate is made, lb./sq. in.

$A_{\text{pr}}$  = Proposed area of the sheet hole opening, which the area

bears = Diameter (M) thick  
mm.

The allowable strength of short-end,  $N \times D$  joints.

The allowable strength of the joint is based on the bearing of MEET MEET sheet on different gauges which used in conjunction with the various sizes of rivets that are commonly used in aircraft construction are tabulated in Bulletin ANCS-7 from which Table III will be taken. Consequently, the bearing strength of short-end rivets in MEET MEET sheet can be obtained without computation.

An examination of the equation for determining the crushing strength of the sheet bearing on the rivet shows that the strength in this respect is theoretically independent of the tensile or yield

distance. Actual tests have shown, however, that the ultimate bearing strength of most metals is reduced if the edge distance in the direction of loading is not equal to at least twice the thickness of the steel.

For smaller edge distances, the bearing strength drops off about in proportion to the decrease in edge distance, so that for an edge distance of one and one-half diameters the bearing strength is only about three-fourths of that obtained for an edge distance of two diameters. This variation of bearing strength is only approximate, and since the tensile strength is more directly related to the tensile diameter, the latter criterion is used by designers.

means that the tear-out diameter is sufficient for any given loading.

If the rivet and sheet are of different materials having different allowable bearing stresses, it is necessary that the lower of the allowable stresses be used in determining the bearing strength of the joint. Bearing failure, in the form of crushing or excessive compression

（来源：《中国统计》1997年第1期）

Announcing  
THE NEW  
**SHAKEPROOF**  
COWL FASTENER

AVIATION  DIVISION

**SHAKEPROOF inc.**  
*fastening Headquarters*

Divisions of International Products Manufactured by KILPATRICK TOOL WORKS 2261 North Western Avenue, Chicago, Illinois  
 Plants at Chicago and Elgin, Illinois In Canada: Toronto Utensil Tools, Ltd., Toronto, Ontario

**SPECIAL BOOKLET!**  
Write for Shokproof Cow  
Fastener booklet! A 21-giving  
engineering data, test re-  
port on physical properties  
and procurement information.

## HAIR SPRING PRECISION - FULL SWING PRODUCTION

## America depends on RELAYS by Guardian

This "G" in the shield... high in the air—scouting the sea—sweeping the land... in jets—guns—bombs—planes—ships—is doing a 100% "bill out" job for America!

Strictly defense, production time open for government approved items, with samples immediately available for any job for the U. S. Army, Army Air Corps, Navy, Naval Air Corps, Marine Corps, Signal Corps, Ordnance.

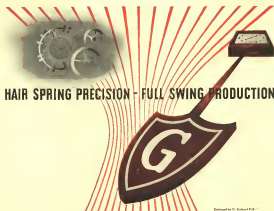
WRITE—WIRE—PHONE

P. S. Want to take advantage of many of our recent developments for that "other G's unit" product? Samples only available now!

# GUARDIAN ELECTRIC

1634 WEST WALNUT STREET CHICAGO, ILLINOIS

LARGEST LINE OF RELAYS SERVING AMERICAN INDUSTRY



Designed by G. Richard Fick



SIMPLEST OF APPROVED CONTROLS  
AVAILABLE ON SHORT NOTICE

OUR SWITCH HANDBOOK  
REMOTE TYPING EQUIPMENT  
TERRITORY CONTROLS  
RADIO CONTROLS  
NAVIGATION CONTROLS  
AIRCRAFT CONTROLS  
SOME RELEASE



duration of the metal are not used, because of the rivet, therefore. Tests have shown, however, that if a rivet joint is made from aluminum alloy is used as a hard sheet such as steel and if the plate is thin enough so that the intensity of the bearing stress exceeds about three times the shear stress, the rivet will fail in shear at a shear stress lower than its normal shear strength determined in tests with thicker sheets.

When bolts are used in a joint the threaded portion of the bolt should should not be used as a bearing surface. The use of threads in bearing is not allowed in any of the components included in the primary structure. In less important installations where a slight pulling of the joint is permissible, the threaded portion may be used, but the allowable bearing load sustained for such a joint should not exceed 25 percent of the rivet shear strength of the bolt.

### PREVENT FAILURE OF SHEET THROUGH THE NET SECTION

The strength of the sheet through the cross-section at which the rivet hole occurs is less than the strength of the cross-section of the sheet at any other point where the cross-sectional area has not been decreased by rivet holes.

The cross-sectional area of the reduced section is called the net cross-sectional area to differentiate it from the gross cross-sectional area, which is unaffected by rivet holes. The tensile strength of the sheet, or the load at which failure will occur is:

$$F_t = \text{tensile strength} \times F \times A_n$$

Where:  
 $F_t$  = ultimate allowable tensile stress of the metal from which the sheet is made ( $\text{lb./sq. in.}$ )  
 $A_n$  = Net cross-sectional area of the sheet measured in a plane which is normal to the direction of the load.

For a width ( $W$ ) of sheet which has but one rivet hole of diameter ( $D$ ), the net cross-sectional area is ( $W(D)$ ). The net area with any other number of rivets can be compared by the same expression by substituting the appropriate number of  $D$ 's, or ( $W(D)$ ).  
Net tensile strength of sheet= $F_t A_n$  ( $W(D)$ )

The ratio of the net cross-sectional area to the gross cross-sectional area is sometimes used in the calculation of the allowable inside load on a riveted joint and in other computations as well. This ratio, called the rivet factor is most easily compared as follows:

$$\text{Rivet factor} = \frac{W}{W(D)}$$

Where only a width of sheet equal to the pitch distance is being considered, the rivet factor is:

$$\text{Rivet factor} = \frac{P}{D}$$

The action when a rivet joint fails is actually more complicated than the simple distance load shown. It has been found that the weakness of the stresses at the edges of the hole is considerably higher than its average. There are also some bending and inside forces, caused upon the rivet in addition to the bearing and shearing forces. If the resultant of the pressure from each plate is assumed to act midway between the sections of the plate, the moment upon the rivet is  $P(D/2) = Pd/2$ , where for plates of equal thickness,  $d$  becomes  $P \times 1$ .

This moment can be balanced by an equal and opposite moment consisting of bearing forces  $T \times F$  (see diagram, Fig. 11) created by the plate upon the head of the rivet thus causing tension at the rivet head. In addition there is a bending of the plate in the case of lap joints since the two forces  $T$ — $P$  are not in the same plane, and the plates, if too thin, rotate in the region until the condition is partially balanced. The following data developed between the plates add somewhat to the strength of the joint, but as of such small and uncertain magnitude that it is always neglected.

Most joints consist of several rivets instead of a single rivet as in the previous example. To determine the strength of such joints it is necessary to take into account the position of the line of action of the resultant of the load passes through the center of resistance of the rivet group it can be assumed that all of the rivets are equally stressed if they are made of the same material. Consequently, it can be assumed that each of the rivets at any one of the same

size, will carry equal loads. Excesses to the outside will be considered later. The present example involves a centrally loaded rivet group (Fig. 12), used to attach the cover plate on a butt joint. Allowable shear loads on the rivets and allowable bearing loads for the 2457 Alclad plates forming the joint are obtained from Table III.

The allowable load which can be transferred by the six  $\times 1$  rivets using 2457 Alclad is:

$$P_r = 6(672 \times 3600) = 1418 \text{ lb.}$$

The allowable load on the 2457 Alclad plate in which the rivet rivets are installed is:

$$P_b = 6(2457 \times 4960) \text{ lb.}$$

The allowable load on the two 2457 Alclad cover plate in which the six  $\times 1$  rivets are installed is:

$$P_c = 6(2457 \times 4920) \text{ lb.}$$

The allowable load which can be transferred by the 2457 plate across the net cross section at A-A is determined as follows:

$$T_{A-A} = 6(672 \times 3600) \text{ lb./sq. in.} \times \text{ANC-5}$$

$$T_{A-A} = 6(672 \times 3600) \text{ lb./sq. in.} \times \text{ANC-5}$$

The allowable load which can be transferred by the 2457 plate across the net cross section at B-B is:

$$T_{B-B} = 6(672 \times 3600) \text{ lb./sq. in.} \times \text{ANC-5}$$

And the allowable load which can be transferred by the 2457 plate across the net cross section at C-C is:

$$T_{C-C} = 6(672 \times 3600) \text{ lb./sq. in.} \times \text{ANC-5}$$

An inspection of the values obtained for the strength of the 2457 plate at the various sections shows that the allowable load on section C-C is less than for the other sections. This is true since the greatest number of rivets at any one section is at this section, thus reducing the net cross-sectional area to a minimum.

However, the most highly stressed section is not necessarily at section C-C. At section A-A the entire load applied to the plate must be transferred across the net cross-section. Thus, the entire load on the joint at the same as the allowable load on this particular cross-section.

The one rivet in row A-A transfers one-sixth of the load into the rivet plates, thus, leaving five-sixths of the load to be transferred across the net cross-section which is at B-B. Since only five-sixths of the load had applied at the rivet is transferred to section B-B, the allowable load on section B-B at 738 lb. corresponds to a total load on the joint of  $6(738 \times 7990) = 3123 \text{ lb.}$  This load is greater than the total joint load previously determined. Consequently, section B-B is not the critical section.

In a similar way, the load required to be transferred across section C-C is only one-half of the total load applied to the rivet. The allowable load on section C-C of 737 lb. therefore, corresponds to a total load on the joint of (Two to page 266)



Fig. 11. Illustration of bearing stress on a lap joint



Fig. 12. Centrally loaded rivet group used to attach cover plate on a butt joint



FIG 1

FIG 2

# Escher Wyss Variable Pitch Propeller

By DR. C. KELLER, *Escher Wyss Engineering Works Ltd., Zurich, Switzerland*

**T**HE ADVANTAGES OFFERED by the variable-pitch propeller are so nearly self-evident that further comment is unnecessary at the present time. It is quite true that current types make possible a more or less satisfactory adaptation—dependent on construction and operating principles—of the propeller to the wide speed and performance ranges of modern airplanes under take-off, cruising and maximum speed conditions. For these purposes between 15 and 30 degrees of pitch angle change are adequate. However, future developments will go far beyond these requirements.

By setting the blades at high pitch, for example, extraordinarily high flying speeds can be obtained in accelerated glide descent without raising engine output.

The feathering of the blades enables the rotation of the engine to be stopped in the event of engine failure, concurrently with the reduction of propeller drag to a minimum, a maneuver that has been found to be of particular value in the case of damage to the propeller of multi-engine airplanes.

By setting the blades at negative pitch angles, on the other hand, the propeller advances the functions of an efficient air brake in descent and during the landing run without necessitating the additional weight of speed brakes. Drifts can thus be carried out at much reduced velocities, which is important especially for military purposes. The normal landing run may be reduced by as much as two-thirds in some cases, a feature that is highly desirable when fully armed vehicles are utilized.

Furthermore, the favorable effect of constant-speed operation on the different flight maneuvers, resulting from the maintenance under all conditions of constant propeller engine rpm, should be noted.

However, for the realization of these demands, the creation of a new and hitherto-unseen design of propeller hub was found necessary as well as of the control and operating mechanisms. Such a type developed systematically and capable not only of meeting the present but also of meeting the future requirements mentioned above is a production at the Escher Wyss works Dösch-

moorwerk on the propeller was much facilitated by studies and suggestions made by the Institute of Dynamics of the Swiss Federal School of Technology (Prof. Dr. J. Ackerer) and by the Technical Section of the Federal Military Department.

The firm of Escher Wyss is particularly the only undertaking to have gained extensive engineering experience in the entire field of high speed rotating machines (steam and water turbines, axial and radial compressors, blowers and pumps as well as variable-pitch marine propellers). The high speeds of modern machines of these types led to the adoption, thirty years ago, of blade designs resembling airfoil sections and even today to obtain the highest degree of efficiency under different operating conditions—of blades controllable, mostly automatically, in actual operation.

The company's long activity in the development of such machines and the application of the experience gained in one specialized field to another effected a solid basis for the creation of a hub suitable for operation under the same (Turn to page 287)

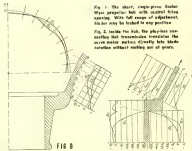


FIG 3

FIG 4

FIG 5

Fig. 3: The short, single-piece Escher Wyss propeller hub with control blade opening. Wide full range of adjustment. Blades may be locked in any position.

Fig. 4: Inside the hub, the flywheel connecting the transmission transmits the motor motor motion directly into blade rotation without making use of gears.



FIG 6



FIG 7



Fig. 6: From the snap disk model a hub was constructed to which a body of sufficient strength was secured.

Fig. 7: Transmission by which the course of hub stresses is determined.

Fig. 8: Graphical representation of hub stresses as determined by transmission measurements.

Fig. 9: Diagrammatic solution of stresses based on transmission measurements.

# Are NUTS Driving You NUTS!



## Blackhawk Developments in Quick-Detachable Socket Wrenches are the Modern Answer . . .

A whole lot has happened to wrenches since open-end and monkey wrenches handled most nut problems. The wrenches of the hour are Blackhawk quick-detachable SOCKET WRENCHES — they're setting new standards in speed, safety and efficiency in aviation, industrial and construction work today because they are expressly engineered to handle the most complicated assembly, service, and maintenance jobs.

## Here's How You Can Speed Up Production!



Don't let your men pick up any old wrench for the job! Make up a combination of selected Blackhawk sockets, attachments, and handles that give them just the right leverage and clearance. (You can build over 25,000 combinations from our 50-plus set of Blackhawk Socket Wrenches.) Today, a Blackhawk socket with a 1/4" opening fits a wall thickness of only .005" — an example of why Blackhawk sockets are preferred over burr-end, adjustable and open-end. Above all, don't waste time making special wrenches, when a combination of standard Blackhawk wrenches does the same work. Find out about "Lock-In" and other exclusive features. If you can't see both ends of a wrench opening from 3/16" to 3/4", call your Blackhawk Industrial Supply Distributor — or write us — for your copy of the informative "Handy Guide".

A Product of  
**BLACKHAWK MFG. CO.**  
Department W242 Milwaukee, Wis.



# BLACKHAWK



# Synthetic Resins In Construction

By H. N. HAUT, Author *Aviary Gaps*

**PART II . . .** In part I, appearing in the March, 1942, issue of AVIATION, the author described the background of modern wood construction. Now, in the following article, some interesting and useful test results of synthetic resin bonding in wood construction are discussed.

It has been illustrated by examining a typical stressed skin wing or a typical monocoque fuselage, of metal. It is seen that even the most ingenious design cannot avoid need of the full compressive strength of the metal, which leads to load levels before the ultimate tensile strength is reached. We, therefore, had a variety of stiffeners, in the form of angles, channels and corrugations, used to support the unstable skin. They were also rigidly attached to the skin with closely spaced rivets and with a corresponding increase in the drag of the surface.

Now Clark\* has shown that for a given weight a thicker shell of lower

density material without stiffeners will support a greater stress than a metal shell with stiffeners and upon this basis is founded one of the plastic airplanes of today. Add to these findings the basic synthetic resin research results, a continued improvement in the technique of forming, compound curves of plastics reinforced metal and a utilization of the plastic properties of the plastics, that is, its susceptibility to laminating and to remain formed (I refer now to the irreversible thermosetting resins) and we have, by a natural succession of events, arrived at the plastic airplane.

## PLASTIC CONSTRUCTION

There has appeared in the literature, descriptions of three plastic airplanes. Eventually all three are based on plastics bonded to plastic reinforced metal. True to tradition, one is reported to use a thermoplastic resin of the bakelite type, and one a phenolic resin and the third a new thermoset plastic resin.



Test panel bonded with low temperature phenolic resin under atmospheric conditions with shearing exposure in the open for over a year.

Model 14-F Bellanca Cubair wing panel bonded with low temperature phenolic resin.





# AQUATITE THE AIRCRAFT Plywood

U. S. Army and Navy specifications  
also, British V specifications for  
military applications

## ENGINEERED for AIRCRAFT

Twenty-five years'  
experience in  
Aircraft Plywood

Our engineers are experienced in the  
application of plywood to aircraft and  
can give you immediate and reliable  
aid on your problems. Write today  
and make arrangements for a confer-  
ence with a Crescent Plywood Co. engineer—no obligation on your part—  
simply want the opportunity of showing  
you how we can help you now.



**THE CRESCENT  
PANEL CO.**  
INCORPORATED

Hot Plate Laminated Plywood

3121 N. MARKET ST.  
LOUISVILLE, KY



A 4-blade contra-rotating propeller  
made by de Havilland.

### De Havilland Developments

The first details on two new developments in all metal propellers made by the de Havilland Aircraft Co. Ltd. have reached us from England. One is a 4-blade for use on engines of 2,000 hp., and over such as are mounted on the Avro Manchester, one of the RAF's heavy bomber types. The other is the de Havilland counter rotating propeller. Both are constant speed, full-feathering types.

With the advance in higher powered supercharged engines for operation at great altitudes, three blades cannot provide enough "bite" to work effectively in the thin atmosphere, unless the propeller has so large a diameter it cannot be accommodated by normal landing gear.

An important feature in the use of metal blades. Not only does metal make possible the three blade section necessary for obtaining the best power efficiency, and the relatively small blade area which permit use of a correspondingly small hub with reduced weight and clearance problems, but also increased maneuverability and maneuverability. It has been found that on forced landings with landing gear retracted, such as sometimes occur in action service, the strong, multiple shockwaves made, can be relied upon to bend backward and form skin, protecting the main body of the engine and the whole airplane from landing damage. As for the blades themselves, 80 percent of those which are damaged in crashes or crashes (including those "holes" by bullets) are replaceable and go back into service.

In the de Havilland 4-blade version the maximum diameter is 14 ft. Other sizes are being built to cover the range of additional horsepower. The 4-blade contra-rotating propeller is one of the latest developments from the de Havilland factory and represents the most



De Havilland 4-blade propeller for  
2,000 hp. engine.

important technical advance since the first patented their first contra-rotating propeller in England on July 30, 1935. The purpose of the contra-prop has been made further in recent discussions in the technical press (see Aviation, Oct. 1941, p. 127). An important advantage is that the counter rotation strengthens the slipstream, eliminating swing at take-off.

In the de Havilland 4-blade, fuselage design features of the modern Hamilton and de Havilland propellers are retained, notably the light alloy forged blade with spoked root, the blade anchorage, and the transmission of longer and centrifugal loads through axial and barrel structures. The mechanical responsiveness of the hub assembly is notable. No details of steel and high-power capacities are available at present.

### Blanket Protection From Shrapnel

A greenhouse blanket of animal hair mat, about one-half inch thick, glued directly to a factory window, has been found to offer almost perfect protection against flying glass, shrapnel and bomb splinters, according to tests conducted by the U. S. Army at Patterson Field, Ohio.

Invented by El G. Mathews of Brown & Mathews, Inc., 122 West 42nd St., New York, N. Y., holders of the Edo Aircraft patent on Lenz Glass, the protective device is bonded by wire mesh. The glass, with this combination was smashed with a sledge hammer bullets were fired through it, and finally the Army tested it with 8 lb. of TNT. Every test is said to show the same result. The glass broke, but it did not spread, rupture or give the protection mat. The explosives dented the mat but no shrapnel or other missiles penetrated. The conditions reached by rank-

## Convoy of Commerce

Off shore—above ground sea lanes among islands—Lockheed Hudson bombers fly guard over ships that carry men and supplies to allow fighting fronts.

These vigilance patrols are part of the first Lockheed Hudson—first American ship to serve with British Coastal Command. In missions, they are the same tough transport design that needed few changes to become a famous bomber.

In missions, they are superior—designed and built to take full advantage of the lessons of total war.

In traditions of performance, they live up to the reputation of the Hudson that helped perform the miracle of Dunkirk—a working hard, working slow, to reach our Axis front.

...for Protection today  
and Progress tomorrow



LOOK TO *Lockheed* FOR LEADERSHIP



William Remondino Builder • Lockheed Aircraft Corporation • Burbank, California



## ATTACK!

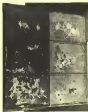
**A**n important factor in any action against the enemy is freedom from interference in communication. Breeze Radar and Signal Disturbing makes possible undistorted reception and transmission of messages from aircraft in ground under all operating conditions. An early Breeze development, life ignition and secondary system shielding is used today on all types of American military and naval aircraft—it is today playing a vital role in helping America gain supremacy of the skies.

With all its plans in full production for the needs of national defense, Breeze is turning out in quantity the equipment which will give America victory in the air, on land and on the sea.

**Breeze** ESTD 1918  
CORPORATION'S INC.  
NEWARK, NEW JERSEY

ing Army officers, industrial executives and others present, it is reported, was that a factory so protected would be safe from anything save a direct hit from a bomb.

Further virtues reported of the protective shelter are based on the fact that it can be applied to each job separately



Window each fitted with protective mat absorbing results of TNT and gasoline bombs.

so that normal ventilation is possible, washed and often pressed gas do not penetrate and it is easily removable when no longer needed.

### Patents Review

The following recent patents on aviation developments have been announced by the U. S. Patent Office.

**Apparatus designed for navigation.** Walter Henry, New Britain, Conn.—A. A. included provisions for circuitry to cause a fuselage and at least two wings operate thereon comprising a pair of opposed electric motors mechanically connected to each other, each of which operates in synchronism with the other in the direction of the fuselage movement in the wing and with other devices that when an engine failure occurs, prevent it from becoming hazardous with other engine movements.

**Control wing structure.** Sir Gordon George A. Ashford, Southampton, Eng.—A. A. included provisions for control, to cause a fuselage and at least two wings operate thereon comprising a fuselage and at least two wings, each of which operates in synchronism with the other in the direction of the fuselage movement in the wing and with other devices that when an engine failure occurs, prevent it from becoming hazardous with other engine movements.

**Wing structure.** Sir Gordon George A. Ashford, Southampton, Eng.—A. A. included provisions for control, to cause a fuselage and at least two wings operate thereon comprising a fuselage and at least two wings, each of which operates in synchronism with the other in the direction of the fuselage movement in the wing and with other devices that when an engine failure occurs, prevent it from becoming hazardous with other engine movements.

(Turn to page 200)

## Use the PRECISIONAIRE to Gage Internal Diameters

- |                                       |   |
|---------------------------------------|---|
| Can Bore—All Collets                  | Work Off on Boring Machine or Grinder         |
| One Second Setting                    | Center-to-Roller and Valve Motion             |
| Changing Roll Bearings                | Engine Cylinders and Gears                    |
| Flange Pin Holes                      | Parts Too Heavy to Be Brought to the Gage     |
| Tap Holes—Several Diameters           | Bore Too Heavy to Be Shaved Off Machine       |
| Cast Shell Bearings                   | Highly Finished Bore Vulnerable to Scratching |
| Tap Holes—In Within 1/16" of the Bore |   |

The Sheffield Precisionaire is extremely fast in action, has the highest degree of accuracy in both process and final inspection—may be used either as a final comparator for checking tolerance or as an indicating gage for classification of parts. It gives an accurate check not only of internal diameter, but ball, conical, end-of-rod and average diameter.

Write for descriptive folder.

**THE SHEFFIELD CORPORATION**  
Piquette—The Sheffield Gage Corp.  
Gage Division • DAYTON, OHIO, U.S.A.

**SHEFFIELD**



As early  
Manufactured Motor—  
Patented March 26, 1891

1891  
1904  
1909

**51 YEARS' EXPERIENCE  
BUILDING ELECTRIC MOTORS!**

1940  
1941  
1942

*Yours for  
Immediate Use*



**SPECIFIC APPLICATION**  
Emerson-Electric Motors for  
aircraft engines, pumps, and  
other aircraft equipment.  
See page 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100.



**EMERSON ELECTRIC Offers the Aviation Industry  
CO-ORDINATED PRODUCTION SKILL AND FACILITIES**



**FACILITIES FOR  
QUALITY PRODUCTION**

*Coordinated for high-speed  
precision production—Emerson-  
Electric's manufacturing facilities  
are available for aviation  
requirements.*

**T**he immediate, direct value to you of Emerson-Electric's 51 years' motor-building experience cannot be estimated—until you are able.

Airplane is daily proving this value to itself—turning to Emerson-Electric—precision production—gearing accuracy with castings and speed in terms of motors correctly designed and precision built to do their assigned jobs.

**AIRPLANE MOTORS COMING OFF THE LINE**

Emerson-Electric Aircraft Motors are already being produced for Airplane Gas Turbines, Hydraulic Units, Fuel Pumps and Turbopumps, also with built-in gear reduction and limit stops.

Contact Emerson-Electric — FOR ENGINEERING SERVICE — FOR PRODUCTION-BUILT AIRCRAFT MOTORS!

THE EMERSON ELECTRIC MANUFACTURING CO.  
ST. LOUIS • Branches: New York • Detroit • Chicago

**EMERSON ELECTRIC**

**5 H. P. and Smaller ELECTRIC MOTORS FOR AIRCRAFT 5 H. P. and Smaller**

# WHEN YOU'RE STRIVING FOR PLANT EFFICIENCY, Don't Forget the Locker Room



## ... equip it with Berger Steel Lockers

To achieve full speed in war output, a clean, modern locker room is almost as important as good materials, modern machines or efficient operators.

That's where Berger Steel Lockers can help more than you may think.

Berger Steel Lockers provide safe, compact, compact storage for employees' clothing and possessions. Like all Berger Steel Storage Equipment, they're strong, fireproof, easy to erect, easy to dismantle and reassemble with-

high salvage, flexible in layout and long life.

Berger engineers—with more than 50 years of experience—know industrial storage needs. They can design for you the best layout of lockers, shelves, racks, bins, cases and benches for greatest efficiency—no wasted space in stocking and unloading of materials, parts, tools and this—no more valuable time in operations—to reduce losses due to damage in storage.

Right now, Production for Victory demands all our tremendous output for war industries. If you are engaged in the production of vital needs, our engineers are ready to assist you immediately, and we shall exert every facility to supply the equipment you need. In any event, we shall be glad to send literature showing the complete Berger line for future use. Write us.

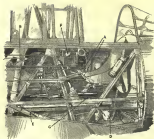
**BERGER MANUFACTURING DIVISION  
REPUBLIC STEEL CORPORATION  
Canton, Ohio**



**BERGER  
STEEL STORAGE  
EQUIPMENT**



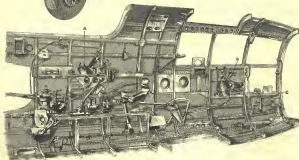




A view of the rear cockpit of the Humberling chassis seat, shows the engine assembly "A" and the electrical control "B" in the bottom. Also shown is the fuel tank in "C" while "D" is the fuel air intake. "E" is the exhaust from the engine and "F" the selector switch for the engine. Forward position of the seat is for the intermediate phase, while the rear position is for regular landing and clearing.

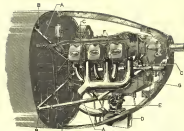


The landing gear, left, of the Humberling chassis is of the fixed type. The "A" is located in the wing from through which held it in place by passing through the hole "B" in the bottom section of the seat "C" is built up of welded surfaces.



On this seat on the page opposite are the two halves of the main section of the Humberling chassis. The main of each half pointing toward the other. These two sections, after being channel-banded and riveted

down, are connected separately in one which facilitates the installation of controls and landing gear. The two halves are then riveted together and become a completed unit. The controls are in "A", the emergency con-



The engine installation, left, in the Humberling chassis model 33 shows a four-cylinder engine block "A" which is attached to the Humberling in four points on either side, as at "B" and supports the engine at four points, two of which are shown at "C" through rubber shock mountings. The selector switch is at "D", the fuel tank at "E", and the fuel intake manifold is at "F".



In the Humberling chassis, the main landing gear strut, shown in the Humberling chassis, which is welded to the wing. As shown in the drawing, part of the landing gear is attached through the fuselage and by which the strut ends are attached to the landing gear.

The head and bottom of the Humberling chassis, left, show a construction of corrugated aluminum alloy of reinforced cross section. The wing is, now, shown in the left view of the seat. The whole seat is mounted on rollers "F" which run on a track in the floor of the ship.



The controls, model "F" and "G" are operated by the main landing gear strut in the front of the seat. "G" is the main wheel, like the other emergency controls, are located, and when not in use are slumped to the side of the cockpit

next to the right of the main section. The main section is, now, shown in the left view of the seat. The whole seat is mounted on rollers "F" which run on a track in the floor of the ship.



Vought-Sikorsky

## Uses **VICKERS** HYDROMOTIVE CONTROLS

Vickers Hydromotive Equipment is used on many of the most modern airplanes. The Vought-Sikorsky "Corsair" illustrated here is representative.

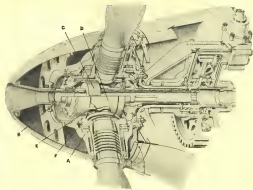
Vickers Hydromotive Controls are high pressure oil hydraulic controls that are so widely used because they do the job dependably, smoothly and accurately... no matter how severe the service.

**VICKERS** Incorporated

1462 DARMAN BLVD., DETROIT, MICHIGAN

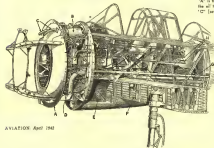


Engineers and Builders of  
Oil Hydraulic Equipment  
Since 1921



Above is a cutaway drawing of the Super-Wyo variable pitch propeller hub - a direct design which operates as follows: The main piston (A) controls all the moving parts and the hollow control tube. "B" valve offers the possibility of filling through the hub and in which is mounted a float piston. "C" The adjusting cylinder "D" moves over the piston "C" under controlled oil pressure to use as the other side of the piston. This cylinder is automatically controlled by the constant speed governor pump, and releases either line of the piston through corresponding lines in the control guide tube "E". The locking device is accommodated in the interior of the adjusting cylinder. The connecting tube "F" causes direct turning of the blade holder "P". Blade can be actuated without dampening the control apparatus. [See whole page 186.]

Receiving the oilless steel truster is shown at left. The valve flange partly explains and using rear section have been removed to show the structure beneath. "A" is the engine oilward end and "B" the oil tank with inlet and outlet pipes. "C" (nearest the end) is the flange. The pipe "D" is a part of the cockpit heater system which carries hot air from around the exhaust collector ring into the heater pipe. "E" is the battery and "F" the fuel tank which is an integral part of the center wing section. Support struts are at "G" and absolutely sealed junction line at "H".



AVIATION April 1941



AEROQUIP CORPORATION  
AEROMATICS DIVISION  
AEROMATICS DIVISION

AEROQUIP SELF-SEALING COUPLINGS



*How accurate  
the instrument?*

## ...HOW PERMANENT THE MAGNET!



So simple to use, it's true. But here's  
why you can't use any other kind of  
magnet — you can't use the kind  
you find in a magnet. Weston's magnet  
is made of a special material that  
gives it the permanent magnetism  
you need. Weston's magnet is the  
only magnet that's permanent.

"How come?" you ask. "But so many  
Weston instruments manufacture in-  
struments, in some 100 years ago are still  
going dependable service throughout in-  
dustries?"

Two the answer — first consider the  
backbone of these Weston's Magnet their  
adventured apt — the magnets have ap-  
parently unchanged — the strength of  
the magnetic field remained constant.  
Neither time, temperature, vibration,  
nor external demagnetizing influences  
have had any effect. Thus with these  
magnets "left in" error due to  
weakening has been "left out."

The secret of the permanency of Weston  
magnets dates back over a half century

ago, when in the middle 1850's the Weston  
established the basic principles of design,  
and manufacturing, which have  
given the world's permanent magnet mag-  
netic life. And it is in these same basic  
magnetic principles which will give mag-  
nets this essential quality of permanency  
— even when modern materials are in-  
volved.

So today in Weston, these same basic  
principles are faithfully carried out  
to give magnets the same lasting perma-  
nency — to provide the same life-expectancy  
— in all instruments which bear  
the Weston name. Weston Electrical In-  
strument Corporation, 501 Polaris Avenue,  
Avenel, New Jersey.



# WESTON

*Instruments*

ANALOG INSTRUMENTS  
ANALOG INSTRUMENTS  
ANALOG INSTRUMENTS

ELECTRIC INSTRUMENTS  
ELECTRIC INSTRUMENTS  
ELECTRIC INSTRUMENTS

AVIATION, April, 1941

117

## New Products

### Dissecting Hangers

With net clearance heights of both ordinary and standard hangars ranging from 25 to 30 ft, the largest aircraft are important structural considerations with the hangar. Three major types of aircraft hangaring are Light Aircraft, General Aviation and Large Aircraft. The largest aircraft hangar in the world is the Thompson Electric Co. B30 Power Air, Cleveland, Ohio. The Thompson hangar is essentially an overhead door hangar with a central door of the expanded polystyrene foam light class or 1 in. extruded solid which provides one-time operation. The doors are built and set by the heavy industrial steel mills, but use of the light development



### Electric Etchers

Announcement in made of electric strength of special design now added to their line by the Berger Electric Mfg. Co., 1110 N. Dearborn and Ave. Chicago, Ill. Made in American models, these switches are specially adapted for marking dies, tools, and other portable equipment for easy, permanent identification of all smooth surfaced steel tools and their keys. Called the Tonside Electric Identifier, it includes both switch and swing lamp models and all of which are contained in a compact, portable case. It is made for both light and heavy use.



ing. A red light tells operator when switch is on, which is turned to desired picking rate. Model A weighs 10 lb. Model B, 25 lb.—*Aviation*, April 1961.

### Screw Gauge

A happy American National Standard Service Gage for establishing backwood and machine sizes, in sizes from No. 1 to 12 inches, is now being offered for free distribution by the Dayton Rogers Mfg. Co., Minneapolis, Minn. Having two sets of graduations—the one on the left of the gage is for outside girth, number or size of wood and machine sizes, while graduations on the right record diameter size of round round stock from  $\frac{1}{8}$  in. to 12 in. Although the size is graduated in  $\frac{1}{8}$  in.,  $\frac{1}{4}$  in.,  $\frac{3}{8}$  in.,



attendance is very easily estimated. Gages are accurately made from mild or thick good quality flat steel, carefully die cut to size and re-baked in oil per cent cooking. Price on request on company letterhead.—Tinsmith, April 20/21

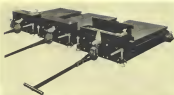
## Thompson "Boto Valve"

Designed to probe a hard valve, like an aircraft engine's overhead valve, the *Valve Tester* is a portable unit that can be introduced directly by Thompson Products Inc., Cleveland, Ohio, and hooked directly at the top, shows in the drawing, opening the valve to readily in the guide without interfering with normal operation. This direct drive the valve from the intaker as valve is opened. Forces inherent within the valve train induce this rotation, which produces a slight tapping action on the valve and block seats. Seat and stem deposits are then said to be removed before the accumulation of these points



can cause blowby or sticking. In addition, it blowby does exist at the point of the block destruction, etc., no one point of the valve face is continuously subjected to the high temperature gases, preventing local overheating and galling of the seating surface. Dynamometer and road tests are used to have proven the design will operate valve life 2-3 times.

—Aronson, April, 1942



## Galvalley

A new metal alloy, Galvalloy, recently introduced by **Metco-Cor**, Box 3093, Fremont Avenue, Los Angeles, Calif., is reported to obtain a perfect soldering bond with aluminum or aluminum alloys without use of flux. It is a 50-50 tin-lead alloy, containing 0.05% antimony, which is used in the form of a paste, allowing the bonding of aluminum or aluminum alloys to these metals. The alloy may be used in many shapes, it is claimed. In fluidized bed soldering, it is used in the form of a filler, to close holes or defects, or in a protective coating on welded joints or other areas where a non-corrosive coating is needed. Under some circumstances after AGS is applied, temporary tape may be used to prevent corrosion until the *Aviation*, April, 1962.

<sup>10</sup>Gross, 1984a.

Operating efficiently at 30 mph, the gray power, cutting a swath of 21 ft, 3 m, is said to have the maximum capacity of 100 tons per hour. The 100-hp engine is a 6-cylinder, 200-cu-in. (3.3-l) Isuzu model. The segments of Washington Mower Co., Steinsburg, Pa., the Grass Planer is hailed by a host, powerful motor, two 10-in.-dia. wheels, and a 10-in.-dia. rear wheel. The planer is said to be rapidly expanding its program. The great speed of the mower, allowing the owner to cut, develops a thick clump left behind on a hillside. In heavy brush, the planer is said to be able to cut off a 10-in.-dia. tree. In addition, regular cutting tends to eliminate weed marks in the ground caused by plows which are said to be a common sight in the area. The planer can be photographed from as high as 1,000 ft. The driver seat also helps to climb rougher, a ladder to prevent water from getting on the surface.—*John A. Dine, 1961.*



### Toledo Scales

[illegible]

one, while another block is being used on same plot. Many difficult tool problems can thus be prevented for subsequent runs with each series of series bars, it is thought. Macmillan & Macmillan, Turin Tool Post Co. made for us an 18 in. long, 3 in. wide, 1/2 in. deep, and similar fixture in which to clamp and make cuttings. Section series in plot of 1000 cuttings per series, loads of 4000 g. material, chromomyl plated handle with working ball are other innovations. To insure accurate indexing in all four positions four precision steel balls are employed in the block.—*Annals, April 1961*

### Improved Target Tool Post

An improved Maxfli ball, having good size and heavy built by D. M. B.







## To concentrate on **FIGHTING POWER**

White-Rodgers offers entirely new developments in autoelectric temperature modulation equipment for the control of —

1. ENGINE COWL FLAPS (BOTH AIR AND LIQUID COOLED).
2. OIL COOLER SHUTTERS OR FLAPS.
3. CABIN TEMPERATURE (BOTH SUPERCHARGED AND NORMAL).
4. CARBURETOR AIR TEMPERATURES.

**MAKE THEM MORE & MORE AUTOMATIC!**



# WHITE-RODGERS ELECTRIC CO.

SAINT LOUIS, MISSOURI

## New Products

to have excellent resistance to acids, alkalis, solvents and oils, to be fireproof and to possess an insulation resistance of safety about 15 to an 80 percent R H.



and 100 deg. F. A tensile strength of 245 psi, a dry dielectric strength (0.02 in. wall thickness) of 3250 psi (a wet dielectric strength of 812 psi after 24 hr. immersion is also claimed for Ethresol Resinoid—*Aviation*, April, 1942).

### Louche 885 Glue

A self-healing stress construction glue, called "Louche 885" is being used for production of wooden wing spars and tail and motor assemblies. Many fastening processes involve the laminating of wood with self-healing non-stress glue to produce built-up spars. Large timbers for assembling spar truss like wing spars and tail and motor parts. Made by J. F. Louche, 444, Duane St., Vancouver, B. C., special procedures are followed in protecting the glue before shipping from the plant, specially prepared inspectors must have watched every step of the manufacturing and testing operations on each batch of glue, to prevent the slightest deviation from specifications. These parts. Every lot of glue leaving Louche plants must have the approval stamp of one of these inspectors. In the

second batches themselves, the glue is mixed in small quantities of about 10 lb. of dry glue each, and mixing procedures and distribution of glue to points of use are rigidly supervised. Strictly controlled small lots of this Louche self-healing construction glue have gone forward in air traveling containers for use in repair of aircraft—*Aviation*, April, 1942.

### New Dumore Motor

An armature motor with a rating of 1 hp. at 1500 rpm has been built by The Dumore Co., 345 E. Basine St., Kansas City. Incorporating a magnetic clutch and brake in its design, the clutch disengages the armature from the gears the motor the speed is stopped and the brake brings the output shaft to stop in a fraction of a second, it is said. An active rotor of twelve magnetized poles, designated B251PC, is available. It can be supplied with the basic motor only, basic motor with clutch, basic motor with single or double gear ratios, and basic motor with single or double gear reductions and magnetic clutch. Possible applications for the motor are coal and slag dig controls, of color and aerial camera controls. Having an overall length of 8 in. and



weighing 4 lb., motor is also available with ratings of 1 hp. at 1500 rpm, 1/2 hp. at 280 rpm, and 1 hp. at 280 rpm—*Aviation*, April 1942.

### Timber-Lock Platform

San Francisco has been made of a Timber-Lock No. 1 platform which does not make problems, as it is said. A design incorporating wood and metal for supporting big motors and deck boards one not impossible can make better use. The Timber-Lock built by Kufeld - Johnson - McRae, 142 Chestnut St., Philadelphia, Pa. is of



rough oak with hand side leg beams tightly welded into deep grooves under length of platform. Deck and beams are bound together with pre-stressed, covered, bonded rods at double-headed 1 in. intervals. Legs are forced steel bars placed to beam by heavy forged metal bolts, and washers on top and bottom of built-in quarter rigid clamp. Also under the leg bolt heads the large diameter steel washer provides wide bearing point and stress increased by rubbing this company item. Available in all standard sizes, plus or minus one vertical or standard leg design, line or on leg construction—*Aviation*, April, 1942.

### Gun Chute Clips

Designed to insure the possibility of jamming and to speed removal of machine gun ammunition chutes not serving the gun and magazine, a new type quick release ammunition box clip is



now in quantity production by Buckeye Corp., Los Angeles, Calif. Principle advantage of the Buckeye clip is that



availability and ease of drawing the pins, even with gloved hands, so that the status may be removed from the gun. Design of the Satchel also allows the possibility of jamming, as the question slide type clip provides a smooth "hedge" between the pins and the frame, over which the cartridge clip pins move smoothly into the conventional equipment. Data now in quantity production are designed for use with the 30-2 and 50 caliber machine guns. They are fitted to the pins and the feed and ejection slide assemblies by means of the standard gun cloth pins. Two spring loaded attaching pins, with finger pads to insert the pins, are connected to the housing. When the finger pads are levered together they release the slides instantly. —*Armour, April, 1942*

#### "Cold Treater"

New informal type submers "Cold Treater" refrigerators maintain low-temperature down to -35 deg. F. for laboratory research and testing, protection, preserving, storage, etc., are located by the **James Refrigerator Co., Inc.** 40 Leitchfield St., Buffalo, N. Y. Built at 3 and 5 cu. ft. capacities, a large single belt gives complete access to interior of the "Cold Treater" which is equipped with self-contained trans-



mission and safety factor, low steps. Adaptable for round or flat products. Because of the holder is Y-shaped, allowing



a perfect right angle alignment of stamp when stamping round objects. Held in place by a "Shoulder Hook" holding device, stamp holds up or down in order to feed its own bottom on varying dimensions of round or oval shapes. —*Armour, April, 1942*

#### Airport Center Strip

Altered path better for the steel is instantly needed or measured in a new center strip for longitudinal and construction joints in airport runway run structure. It is fabricated from welded metal based in design conforming to current standards and meets in any required length provided as desired for



low scaled condensing unit ready to plug in and use. Standard control measures improvements from 3 deg. F. down to 35 below. Cabinet is available with any specialized type of containers, racks or shelves. —*Armour, April, 1942*

#### Safe Stamping Holders

Developed for safety in heavier stamp stamping operations on steel products. **James H. Wardens & Co., 2903 Forbes St., Pittsburgh, Pa.**, announce a steel stamp holding device. When installation required to stamp workpieces identifies size and other vital data, will find the stamping holder desirable from its size,

weight and safety factor, low steps. Adaptable for round or flat products. Because of the holder is Y-shaped, allowing

#### Crescent Truck

Plants requiring lift-truck facilities may find type "LSC" of the **Crescent Truck Co., Lehigh, Pa.**, economical in cost and operation. The lift-truck for use with 7 in. hand-truck slides is said to replace three to five hand-trucks at a cost of one-third the weight of a hoist. Truck is operated by turning platform under slide, control pumps on foot pedal and also a full three inches, and is lowered by means of release lever on dash controlled by hydraulic check. The LSC is capacity mechanism, according to manufacturers, is available at half price than full price of other lift-trucks. —*Armour, April, 1942*

#### H-E Relay

Completely redesigned and improved to insure long life under severe conditions, a silent mercury relay has been announced by the **H-E Electric Co., 2130 N. Second St., Philadelphia, Pa.** Three important gains are said to result from the new design. The mounting and support frame that held the mercury tube were eliminated, thereby releasing strategic materials for other war purposes, the mercury tube was



## The B.F. Goodrich Airplane of the month The **BOEING FLYING FORTRESS**

**EVERYONE** is struck with today's awe-inspiring events in battle with Boeing's famous B-29 Flying Fortress. These great range—their tremendous speed and head-on courage play a vital role in Democracy's battle. High above oceans, deserts, and mountains, these superb aircraft are carrying the fight to the backyards of dictators.

Like many of our country's foremost military weapons, the Flying Fortresses are B.F. Goodrich equipped. In the air, B.F. Goodrich has done and did in making Fuel Tanks improve their performance.

Since During take-offs and landings, Streamlined Airplane Tires and Expandable Tail Brakes increase their safety of operation.

More than 70 B.F. Goodrich war-joint products are now in use on American military airplanes. B.F. Goodrich is also helping our overseas old pilots across the miles of flight. B.F. Goodrich relays the word — makers of the B-29 Bomber.

*Boeing flies with*  
**B.F. Goodrich**  
**FIRST IN RUBBER**

*No. 2 of a series.*





B.F. GOODRICH RUBBER RESEARCH FOR THE

# Airplane industry



## How Expander Tube Brakes improve a pilot's ground-control!

**I**N THE EARLY DAYS of flying, aircraft brakes were *passive* like automobile brakes. They were heavy-brake shoe cleaners were not *active*, leading to uneven wear and a tendency to grab. Re-pin and adjustment were needed frequently.

When B. F. Goodrich developed the Expander Tube Brake, it was hailed as an important contribution to the entire aviation industry. Greatly improved controllability of planes aided against cross winds... take-offs and landings that are safer, smoother, have revealed where planes are equipped with E. T. Brakes.

### How the E. T. Brake Operates

The Expander Tube Brake is attached rigidly to the wheel axle in service, is *inactive* of a series of curved brake lining blocks that form a complete circle. These blocks are expanded radially to engage the outer surface of the brake drum, which is attached to the airplane wheel and revolves with it.

Immediately inside this circle of brake lining blocks, securely placed between the blocks and

brake frame, is a flat band-shaped tube of synthetic rubber, reinforced with fabric. This is the B. F. Goodrich Expander Tube. The Expander Tube has a collapsed state, evenly sandwiched across the entire tube which is connected to a hydraulic lining.

Application of the braking fluid under pressure causes the B. F. Goodrich Expander Tube to expand uniformly under the full circle of brake lining blocks. When these blocks are forced against the revolving brake drum, the plane comes to a sure, smooth stop and maintains the landing controllability and controllability.

The B. F. Goodrich E. T. Brake is equally effective whether the plane is going forward or backward. This feature has proved especially helpful when the plane is parked.

The manufacturers of military and naval planes are specifying "B. F. Goodrich Expander Tube Brakes" in rapidly increasing numbers. More and more of the major air lines are demanding B. F. Goodrich E. T. Brakes on their transport planes... they are a favorite of light plane owners everywhere.

## Airplane landings inside a building make SAFER LANDINGS OUT-OF-DOORS!



**OVERVIEW** of the Expander Tube principle. A rubber tube fills with fluid and expands. This causes the curved brake blocks early into contact with the brake lining. Control is effected smoothly and evenly all around the brake drum.

**SAFETY** feature developed by B. F. Goodrich engineers has not only been responsible for many improvements in E. T. Brakes... but was actually responsible for the development of the brake itself. Wheel and brake to be used are attached to a rotating arm. Band wheel rotates at adjustable speeds and loads. Mounted are 12 curved segments, meeting road wheels, then rotating aspect of a plane's landing. Brakes are applied and released by means of a lever, which serves as a control. This machine has been of extreme value in the development of water, coast-off, E. T. Brakes. A new braking system, which, the most modern and best, is now under construction in the Goodrich laboratories.



**EXPANDER TUBE TESTING** With wartime stability extended over areas ranging from great heights to sub-zero weather, a question of real importance is "How does temperature affect the E. T. Brake?" To supply the answer to this, B. F. Goodrich engineers constructed with this machine. An electrically heated and was constructed with temperature controls between 70° F. and 100° F. To test the low temperatures, 40 100 both were developed which had temperature ranges from 70° F. to 100° F. below zero. Pressure on the Expander Tube can be varied from 6 to 100 lb. per sq. inch. The resulting search for continuous information such as this is what makes B. F. Goodrich truly "First in Rubber."



*In war or peace*

**Goodrich**

FIRST IN RUBBER

MAKERS OF B. F. GOODRICH TIRES AND OVER 50 RUBBER AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES



**JAMES E. P. GOODRICH CO-PIER**—One of the greatest contributions to flying safety is the B. F. Goodrich De-Lite. A sheet of specially compounded rubber containing silver is affixed to the leading edges of a plane's wings, tail, etc. These silver surfaces are replaced in sequence by an engine-driven pump. Thus, in an emergency, the plane's wings, the pulsating rubber tubes cause a shock and the aircraft can be brought down. B. F. Goodrich De-Lite is now used by the country's leading airlines and on standard equipment on many types of military aircraft.



**B. F. GOODRICH SILVER-TOWN AIRPLANE TIRES** are built throughout with Diamond B. F. Goodrich "Fire-Resistant" and goodly reserves of the strongest rubber. Today thousands of pilots are making their "Silver-Town" tires in places of all types... from high over-cabin engines and private planes to huge commercial and military bomber aircraft.



**B. F. GOODRICH FUEL AND OIL HOSE** is made with a synthetic tube and two braided metal wires. The synthetic rubber is gas-tight resistant, and prevents peeling and swelling.

**B. F. GOODRICH BEARINGS** are designed to carry full loads and control cables through the fire wall and bulkheads, to allow free travel of the control cables through the bulkheads and for easy in other places where it is desired to absorb the vibrations of cables and wires.



## **HARTZELL** **FULL SPEED** **on the road to** **VICTORY!**

The greatly increased floor space and equipment announced a year ago are being used at full capacity for Hartzell propeller production. Expedited production, but not the slightest let-down in the sleek which have made the Hartzell trademark "a mark of experienced design and honest craftsmanship."

**HARTZELL**  
**PROPELLER COMPANY**  
Piquette, Ohio, U.S.A.

### **KEEP FLOODLIGHTS** **TURNING!**

WITH  
48 INCH  
WOOD  
TABLE  
\$19.50  
3 RPM

### **Roto-sho** **TURNTABLE**

14 inch TABLE  
Carries 200 lbs.

48 inch TABLE  
Carries 400 lbs.

All steel 16 gauge  
Operator's controls

Guaranteed 1 year  
Self starting

115 A.C. 60 cycles

Special Setups to Order

**GENERAL**  
**DIE AND STAMPING CORP.**  
245 CANAL STREET  
NEW YORK CITY, N. Y.

made secure by a single metal band which gives them the stability of the permanent design, and, third, the area for forward fastening and connecting was built. Finally simplifying installation and streamlining design of tube housings tend to have been noted to 10,000,000 operations without a failure. It has only one warning point. That is available for either A.C. or D.C., and is rated at 25 amp, 115 v., one hp.—*Aviation, April, 1942*

### **Fines Tube Cut-Off Machine**

For high production cutting of quantities of tube or rod to the exact length. The Penn Engineering Co., 123 Main St., Easton, Pa., have a new semi-automatic model. The unit consists of a rotary pulser on which is mounted a motor driven friction saw or abrasive disk on a rotating carriage. Saw carriage is made V-belt driven, and both motor and saw are mounted on a single carriage, driven on ball bearings. Yellow blocks. Some of carriage travel is controlled by readily adjustable stops. An automatic stroke, which holds tube during cutting, closes automatically on handle on provided saw carriage in



pushed down. Check is mounted by 4-way automatic air valve in base of machine. Check can be switched so as to provide stop degree cut up to 45 degrees available for tubes up to 3 in., and may be changed quickly. Ball bearing motor, 3/4 hp., 7 1/2 in., is connected to starting switch with overload protection. Saw speeds in of high speeds after steel.—*Aviation, April, 1942*

### **Turne Slip**

A new member of die casting type patterns has been added to the line of casting equipment made by Turner Products, Inc., 6125 S. Central Ave., Los Angeles, Calif. Called Turne Slip, it is

## **CLEVELAND** **AIRCRAFT** **LEATHERS**

*All grades... All types*

hold the

### **SPOT-LIGHT**

with

## **AEROKROME**

● In its most recent development, Cleveland Tanning's system in the field of aircraft leathers has resulted in the development of a real leather... a completely efficient and attractive leather covering for every aircraft use. AEROKROME. This specialized leather product is a light weight, wear resisting, tough covering for seats and interiors that is available in a full line of both regular bonded leathers for upholstery and special covering requirements. And, AEROKROME may be hot stamped or finished to meet required colors.

● Knowledge and experience stand behind Cleveland Tanning Aircraft Leather. Cleveland's service to your fleet more than 30 years and covers all types of commercial leathers. This "one-stop" is available in the engineering and production staffs of important defense units. Inquiries are invited to Cleveland quote on your leather requirements.

*80 Years on Leathers*  
**CLEVELAND TANNING**  
*Company*

SOLE LEATHER AGENTS FOR  
**PUMPER LEATHER COMPANY, INC.**  
PUMPER AVE. & JENNINGS ST.  
CLEVELAND, OHIO

**B. F. GOODRICH - AERONAUTICAL DIVISION - AKRON, OHIO**

**FLEETWINGS**  
helps U.S. Eaglets  
to Soar!



**S**TURDY and maneuverable, the Shagong new Fleetwings house tender is a ship that U. S. Army Rivers are proud to pilot.

She's got 450 "hours" under her commercial engine rating. She's all welded . . . the world's first airplane built principally of stainless steel.

planned in designing and building both airplanes and airplane parts . . . who have developed new techniques for fabricating stainless steel, aluminum alloys and other materials . . . are pleased that we are surprised by the heavy DR accounted for by the United States' airlines.

Flourishing, while concentrating on

immediate production jobs, is also seen in today's developments that mean bigger, faster, tougher weapons for tomorrow.

**FLEETWINGS**  
Incorporated  
DRYDOL - PENNSYLVANIA

Standard steel ribs for foot workplaces are now quickly fitted at Heston; it's more than 15 ribs in one operation . . . the hydraulic rubber press sets four leading struts. Heston's production engineers have fitted the new process onto their own span-welded fabricated ribs. For other standard steel parts, Heston's automatic-line production system . . . describes the new machine layout and portable, multiple-sized welding machines . . . has amplified each worker's job and vastly increased output.



To speed spot welding of Alclad, Flotwings has developed a new chemical cleaning process for mass-producing cleaning of Alclad parts prior to welding. The Flotwings method permits spotwelding at any time within three days after cleaning, and also helps produce consistently good welds. Want details?



"Trillies make perforation and perforating in no time." Making hydraulic equipment... fabricating and working the leading drilling assets... manufacture, turning out tanks, accessories, hatches, turret rings and other assets parts... these jobs call for maximum reliability. Fluorocore engineers have found that by painting all machines, lugs, and other equipment with light gray and bright yellow paints, the improved visibility speeds production perforation considerably. This is just one of the "trillion-dollar trills" that help Fluorocore get ahead in the new field.

"KEEP 'EM FLYING!"  
**FLEETWINGS**  
*Incorporated*

AVIATION, April 1941

### New Products

indicator of 700 mph. ranges recently donated for the Army by Kollman Instruments Div. of Square D. Co., 80-08 43rd Ave., Elmhurst, N. Y. In this new type, the speed is broadcast in miles per hour as indicated by the rotating radial. This pointer makes seven complete revolutions of the dial for the full range, or one revolution for every hundred mph. Air speed can be read to one mph at any speed. Kollman Sensitive Air Speed Indicator is also available in 500 and 1000 mph. ranges.—ALFARNO, April, 1947.

### Trans Blackout Ventilators

For writing Marlow plans, The Trane Co., La Crosse, Wis., offers positive ventilation with their Blackout Ventilators. These are available in three basic models: Exhaust unit, Summer Supply Unit, and Winter Supply Unit, each being light- and weather-proof. The Summer Supply Unit is designed to provide large volumes of outside air with perceptible moisture at all times. Use of a unit of this type is generally found necessary in large industrial plants or where ventilation is

[illegible]

Speed indicator

Increasing speed of ordinary travel is reflected in the new timetable for most



### PRACTICAL DATA FOR PRESENT PROBLEMS

Here are two books designed to help users of Molybdenum steels and tools to conserve oil alloying elements, and possibly steel and iron, by getting the most in the way of strength, toughness and wear resistance with the lowest alloy content.

"MOLYBDENUM IN STEEL" covers the fundamental metallurgy of Molybdenum steels. Next treat-

ment - physical properties - applications - of a number of basic stock are treated at length.

"MOLYBDENUM IN CAST IRON" covers the effect of Molybdenum in gray iron, giving suggested analyses for practical applications and detailed dis-

Both books will gladly be sent free on request.

1000

сп-мт Сопрану

• New York City

EVIDENCE April 1968

© 2004 Blackwell Publishing Ltd *Journal of Internal Medicine* 255: 105–112

**Climax Molybdenum Company**  
500 Fifth Avenue • New York City

### New Products

### Challenge Tool Box Shell

What to do with the tool box on the work bench has been answered by the Challenge Machinery Co., Grand Haven, Mich., with a new tool box shelf for use on Challenge Cast-Iron Top Benches. Shelf provides convenient place for the tool box within easy reach of worker, yet out of the way of his work. Bring up almost the bench, tool box drawers can be opened without bending; anything on bench top, which then becomes almost entirely available as work space. The new shelf can be attached in any new or old Challenge Cast-Iron Top Bench.

<sup>1</sup> "Catskills Chaff", *The Sun* 11-14-41, p. 10. The article included two photos and stated that just played in his many programs in Catskills Theater Co. before Dr. Armand Zieve, 1941.

**Accessories**—All skid steers and lifts engineered data, dimensions and tolerances, prices are furnished illustrated with six drawings and photos. Catalog No. 120. Jergin Supply Co. 1115 Ave. W. 7TH St., Mankato, Minn.

parts of a message—German ships' catching dozens of pilot boats, being spotted near the lines, and threatened by onset of a heavy storming from across the bay. One boat can be seen in the rear and another in the foreground. Captain slowly and in silence is surrounded by men. American ships and the Navy are

[illegible]

On St. 5-477, an already developed new case (Florida State's Speed Indicator System with Remote Vehicle Speed Control equipment) which will further enhance ability of law enforcement. Bureau Policy Unit, Columbia, Md.

"**Smoking, Drinking?**"—New 8-page booklet summarizes some important studies on smoking and drinking habits. For more information, contact: National Cancer Institute, 1014 Wood Park Ave., Cincinnati, Ohio.

various shades of pink. Have Island New York, Inc., 125 Joe (Queens St., Forest Hill).

particular countries (see page 1044-1045). Collection of financial instruments containing information on all current terms with details of spending characteristics and income flows giving important clues and to evaluate requirements. Among new features is introduction of Standard Accounting System.

AVIATION April 1942



### Cabin Trim Interior

The 42" sample card in the current series of suggestions for effectively decorating and upholstering airplanes after takeoff has been designed by the New York N.Y. in their No. 346 Style #206045. Chair Upholstery is made entirely of the house pass wood and red pine log, continuous screen, firm solid, and is a good tone. Schaeffel & Goring Upholsterers #16045 is also in all wood broadcloth. The inclusion of several colors in this cloth makes a variety of color combinations possible. Upholsterers and chair cloth. Schaeffel & Goring #5655, one of several colors in company's black pattern, contrasts suitably with the other two upholsterers. Company has supplied the "Maverick" design for the chair. The chair was made by Schaeffel & Goring, 2000.

## WINDOW SHOPPING

ward types. More general information available in 1970 in booklet, "Facts about Kluksoma, Alameda, Sacramento." Kluksoma Industries, Div. of Spangco & Co., 21-23 42nd Ave., Kluksoma, N. Y.

[illegible]

**Transmont** — New heliostat designed specifically to store and pump oil from transmont. Made from stainless steel. Transmont Industries, Inc., 10 W. Van Ness St., Chicago, Ill.

**Automatic Transmontant Control**—Just off

[illegible]

Gift and Accession Marks—Gift Marks—  
 another donation and accession design and  
 construction of label design across the  
 pointing to as well as general suggestions in  
 1964) you had seen at the time. (Accession  
 Mark another donation design (reading in  
 design, construction, use and style of each)

Florida State Board of Education, Tallahassee, Fla.

Alvin L. Karpis, 35, was charged with kidnaping, robbing, and holding for ransom of Edward G. Bremer, Chicago banker, and of Dr. George A. Harbo, St. Louis, Mo., physician. Bremer was freed after a ransom of \$200,000 was paid.

[illegible]

Dr. J. W. McMillan Co., 1224 S. Hope St., Los Angeles, Calif.

# No Other Metal Has *all* the Good



REPUBLIC INDUSTRIES, INC., NEW YORK

## REPUBLIC *Enduro*

Other Republic products include Alloy Steels—Electricity® Aircraft Tubing—Upson Bolts, Nuts and

# Qualities of Stainless Steel!

Some metals—alloy steels, for instance—possess, among other qualities, high strength and toughness. Some may resist corrosion, oxidation or abrasion. Still others may be readily fabricated and welded. Most metals have one or several outstanding qualities.

But no other metal provides all these qualities in the uniformly high degree found in stainless steel—especially Republic Enduro® Stainless Steel.

Republic Enduro provides high strength-to-weight ratio; high resistance to corrosion, elevated temperatures and wear; resistance to stress in sub-zero use. It is easy to weld—may be machined and otherwise worked without difficulty.

For this reason, ENDURO has become one of the essential materials of the Aviation Industry—and more and more of Republic's

tremendous capacity as the world's largest producer of alloy, stainless and "aircraft quality" steels is being delivered to plane and engine makers to swell the stream of *Production for Victory*.

In qualities are helping produce better wing structures, control surfaces, cowling, fire walls, ammunition boxes and chutes, collector rings, supercharger parts, exhaust stacks, air intake pipes, oil tanks, pontoons, radiators and other important parts of our rapidly growing air armada.

*Specific details and technical data on Republic ENDURO Stainless Steel, together with information on fabrication and welding, are contained in an interesting series of booklets. Ask us for whatever information you would like to have.*

### REPUBLIC STEEL CORPORATION

Alloy Steel Division: Hamilton, Ohio • Special-Steels Division: Cleveland, Ohio  
Refractory Manufacturing Division: Eastlake, Ohio  
Pipe, Sheet Products Division: Lorain and Lakewood, Ohio  
Steel Division: Steel Division • Youngstown, Ohio

Now U. S. Air Mail



## STAINLESS STEEL

Rivets—Pipe—Sheets—Trussco Hanger Doors and Building Products—Berger Lockers and Shelving.



# SCHATZ

*Precision*  
**AIRCRAFT  
BALL BEARINGS**



SCHATZ PIONEERED IN THE BALL BEARING INDUSTRY • INTRODUCED MANY IMPROVEMENTS IN CONSTRUCTION • ESTABLISHED NEW STANDARDS IN BALL BEARING PRACTICE • THIS SKILL, KNOWLEDGE AND EXPERIENCE IS TODAY REFLECTED IN THE SUPERIOR PERFORMANCE OF ALL SCHATZ CONTROL BEARINGS •

THE SCHATZ MANUFACTURING CO.  
POUGHKEEPSIE, N. Y.

Branch Office: 5440 South Tower • Chicago Office: 808 S. Wabash Ave.  
Overseas Office: 445 Southern Building • Los Angeles Office: 3419 Wilshire Blvd.

AVIATION April 1942

## AVIATION'S SUBCONTRACTORS SECTION

IN THIS NEW SUBCONTRACTORS SECTION, Aviation offers a service designed to simplify the search for outside manufacturing facilities and thus speed the process of subcontracting.

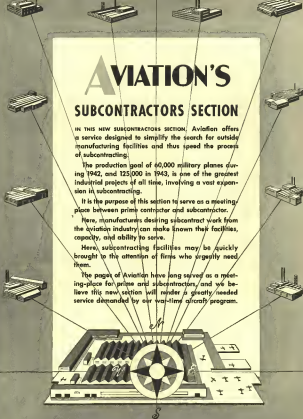
The production goal of 60,000 military planes during 1942, and 125,000 in 1943, is one of the greatest industrial projects of all time, involving a vast expansion in subcontracting.

It is the purpose of this section to serve as a meeting place between prime contractor and subcontractor.

Here, manufacturers desiring subcontract work from the aviation industry can make known their facilities, capacity, and ability to serve.

Here, subcontracting facilities may be quickly brought to the attention of firms who urgently need them.

The pages of Aviation have long served as a meeting-place for prime and subcontractors, and we believe this new section will render a greatly needed service demanded by our war-time aircraft program.



CALIST THERMOSTATIC SWITCH  
One of many instruments  
that control modern  
aircraft, shown in close-up

THE HEAT BEAT—This device  
is used in 2 engine models  
to prevent overheating and  
is not affected by altitude,  
altitude or vibration.

## MORE KLIXON CONTROLS

for Aircraft  
Applications

A-1110—Anti-Overheat and  
vibration switch to control  
engine exhaust temperature  
and prevent engine failure.

CALIST THERMOSTATIC  
—This advanced control is  
superior to other controls  
in altitude.



### KLIXON AIRCRAFT CIRCUIT BREAKERS

These breakers—push button  
and toggle types—are available  
in ratings through 150 amps.

They have high rupturing capacities—six times as high  
—and give complete fail-safe protection to valuable  
equipment. Ideal for installations requiring complete dem.

# KLIXON

Spencer Thermostat Co., Attleboro, Massachusetts

MANUFACTURERS OF THERMOSTATS AND TEMPERATURE CONTROLS FOR AIRCRAFT, CARBON, RAILROADS, SHIPS AND INDUSTRIES

### 10,000 Contractors

Subcontractors in aircraft industry  
are approaching a total of 10,000 since  
Automated Chamber of Commerce.

In addition, the work is spread among  
nearly 20,000 parts and materials vendors.  
Subcontracting is turned-out  
work to be done by specialists, while  
working is supplying standard parts and  
materials like bolts, nuts and gears.

Principal items subcontracted include  
control surfaces, engine mounts, landing  
gear wing tips, body racks, various  
mechanisms, tests.

Subcontractors now supplying contract  
equipment formerly produced such  
things as access ladders, sewing ma-  
chines, printing presses, fitting tools,  
cure ovens, welding machines.

In 1961, 248 plants in 80 cities sup-  
plied parts for the B-72. This year  
more work is involved. Parts for  
another plane come from 254 cities in  
26 states; vendors in all 48 states supply  
the same project.

An aircraft manufacturer company estimates  
that as 140 subcontractors do 240 man-hours of work a month  
the vendor contribute even more work.

Most of the prime manufacturers  
maintain high engineering staffs to work  
with the subcontractors. This includes a  
large program of teaching the former  
civilian produces the fine technical  
and precision of aircraft construction.

### NEW SUBCONTRACTING PLAN

The WPA and National Association  
of Manufacturers are about to conduct  
a series of experiments to test the  
"rotating office" plan for distributing  
war production work in the Chicago  
and two or three other areas.

The plan's principal feature is a  
directory of subcontracting opportuni-  
ties compiled by a central bureau and  
made available to interested subcon-  
tractors each week. All details of sub-  
contracting, including numbers and facilities  
are taken from the prime contractor's  
master operating charts and are sent  
and sent to Washington for listing in the  
directory.

The prime contractor specifies in his  
drawings the type of machinery required  
to produce the job and describes the  
essential phases of the operation. The  
potential subcontractor having assigned  
corresponding codes to his machinery,  
receives the necessary work order book  
through it for the scale drawings of his  
own machinery and determines  
whether or not there is a job available  
for him.

The NAM is understood to be pre-  
paring a wide distribution of the details  
of this plan to all potential subcontractors.  
Arrangements are also being  
made for savings with prime manu-  
facturers in the areas to be tested.

## Veterans of the Airlines...



For the full story on the Douglas DC Series Transports, see the full story on the Douglas DC Series Transports.

## DOUGLAS DC TRANSPORTS and ELASTIC STOP NUTS

Since 1938, more than 500 Douglas DC Series Trans-  
port Airplanes . . . in the air 200,400,000 hours . . .  
have flown over 350,000,000 miles. The meaning  
of this remarkable record, in terms of safe and  
rapid transportation, is well known.

One important reason for this performance,  
and for the fact that these ships are still in top  
flying condition, is that they are selected  
throughout with vibration-proof Elastic Stop  
Nuts . . . more than 30,000 on each ship.

These self-locking self-gripping nuts are  
used today, at vital structural and second-  
ary connections, on every military and  
transport airplane built in the Western  
Hemisphere . . . and on innumerable  
other classes of mechanical and  
electrical equipment . . . including  
many of America's tools of war.

ELASTIC STOP NUT CORPORATION  
2700 WASHINGTON ROAD • UNION, NEW JERSEY

See ELASTIC STOP NUTS  
on your products and equip-  
ment. Sample sets will be  
furnished without cost or obligation.



CHAMBER OF COMMERCE



# How to pull extra Man Hours out of a Glass Tube...



**ONE REVENUEHUNT** — one source of lighting is actually needed to thousands of industrial plants are reaped in real war production. Some of these plants are public, city customers of power. All they want is a modern lighting system, show them how to get extra out of their present lighting by making and changing lamps and reflectors, or painting walls and ceilings a light color, and by replacing burned-out lamps promptly with G-E Mazda lamps.

Read how G-E Fluorescent Lighting — America's new 24-hour daylight — is adding millions of productive man-hours to wartime industry by speeding production... reducing spoilage... preventing accidents... making seeing easier



**TODAY IN 7 MODERN PLANTS** men and women work faster and do it under the thin glass lamps that are helping war workers produce more tanks and bombers and sea-mine guns. Back of these G-E fluorescent lamp factories is G-E's Lamp Development Laboratory, where they still do one of many warlike activities: checking to see that G-E Mazda T lamps are "brighter longer."



**HOW AMERICAN PLANE PRODUCTION** makes its goal, more tanks will be due to a kind of light. For it means workers like this Army General are being made faster by the cool, white daylight of G-E Mazda T lamps. For the industry spends less spoilage, less material on scrapped pieces. Says a machine shop: "70% fewer accidents, less waste." The cost of having good light for maximum results, says a machine and electrical manufacturer, "underlines the fact that an efficient machine adds more than speed, accuracy, or work-life."



**30 FEWER HEADACHE TABLETS** are needed to see plants since G-E fluorescent lighting has revealed. By getting good lighting in your industrial environment, you are helping workers avoid stress, eye strain, and do their jobs more efficiently.



**EXPERIENCED FUTURE MANUFACTURERS** are made more than fluorescent lamps, which are tested and certified by Electrical Testing Laboratories to maximum specifications for good service. The next time you see a fluorescent lamp, look for the G-E logo on the label.

**10 MILLION OF G-E MAZDA T** fluorescent lamps were installed in the largest new warplane plant. Officials say improvement of thousands of different parts would be a costly headache in ordinary lighting. For the 100,000 G-E MAZDA T lamps in this plant give war workers constant improvement and reduced "dull" times when what G-E fluorescent lighting can do for them.

**THE BATTLE OF 1943** is already being waged out in industrial darkness rooms like this one, showing how serious equipment for accurate parts under cool, white daylight installed by G-E MAZDA T lamps. Effective war work and less stress make fewer mistakes, get more done than with ordinary lighting.

**NO TIME OUT** taking work over to a window in the 24-hour "night daylight" (Mazda fluorescent G-E Mazda T lamps work steadily in that way, even when a real war machine (Fluorescent) is spoiled. Work is stopped, lost time, because they conserve energy through better energy management. But your G-E lamp supplier is your General Electric Co., Niagara Park, Cleveland, O.

**G-E MAZDA LAMPS**  
**GENERAL ELECTRIC**  
*Made to stay brighter longer*





# National's PART IN AMERICA'S WAR PROGRAM



In every branch of Uncle Sam's Armed Forces you will find National Quality Sand and Permanent Mold Aluminum Castings. Because of our long experience in making quality products, we were selected to produce castings for every branch of Uncle Sam's Armed Forces... A good thing to remember when normal times arrive.



Make  
**NATIONAL Your Source of Supply**  
FOR SAND AND PERMANENT MOLD  
ALUMINUM CASTINGS

**THE NATIONAL BRONZE AND ALUMINUM FOUNDRY CO.**

Twain Plaza, Cleveland, Ohio

NEW YORK, 131 Broadway  
DETROIT, Stephenson Bldg.

CHICAGO, 186 W. Randolph  
LOS ANGELES, 405 S. Hill

National  
CASTINGS  
ARE BEING WIDELY  
USED TO SPEED  
VICTORY

## SIDE SLIPS



•WE HAITENED to be present on a very old aviation story. Some men involved in clearing up the weeds in back of our old hangar came upon the fuselage section of an old Curtiss JN-4, affectionately known as "Jenny" to thousands of prominent individuals in the aviation industry today. The hangar had been carefully set up on blocks by some unknown owner, who probably thought he was saving a valuable commodity against the days of his old age. It was very much like looking upon the well-scrubbed of care men at the ruins of an ancient temple, and, like the carpenter in "After in Wonderland" we shed a bitter tear.

God knows, the facts might as well be laid: the merest life of our old friend has passed, the day of the Jenny is gone forever. A disabled 40 miles per hour top speed can't compete with the 400 to 500 mph so lightly dreamed by today's engineers, nor can a stalling of from 4 feet to 4,000 feet, depending on

could never be produced. If the day was not longer, one lot, if the original setting of the story was not history and the tale was at hand, one got off and finished. Otherwise one simply got off and stayed there or four feet off the ground and steady obstacles interrupted the flight.

Outside of a microphone, the instrument board was decorated only with letters which always seemed spectators as to what they had been intended for. They also consisted of letters for hanging gloves, looking up the opening rule for the student studying a railroad map at two, and enabled one to put the cheering gun in the back of the head.

The engine was control downward

presumably for stability, however one couldn't help but wonder what the stability characteristics had been before that. The rubber arms spread the occupants with grace and the endurance all came out in a lost field at the top of the crop held the ship inverted for too long. Everything on the signal was exposed to the elements, and when a man stood up at the engine, the pilot selected the best spot available within two minutes of diving time.

The instructor code in the "golden rule," calculating when happened to him when the Jenny spun in, whereas (Turn to page 284)

weather, compete with the 40,000 feet at which today's air battles are being fought.

However, it was a fearful and wonderful machine which had been devised by Glenn Curtiss and his crew of geniuses. Many of these geniuses came from the farms about Hammondsport, N. Y., and some of them are back on those same farms, happy and contented in the knowledge that they helped lay the cornerstone of modern aviation.

Drawings for the Jenny were made on white-washed factory walls, and design was accomplished by standing off and squinting at the longeron, boom, or wing stretched. It is surprising how close they came to the most sophisticated plans, and surely a modern instructor is divided to find his idea anticipated by another master of 1914 designs.

Flying a Jenny was a liberal education in itself. Never a dull moment. After an appropriate period of warming up, one "reared it up," and it rattled with the excitement reading, swung away the wheel, rolled, gave her the gas, and started on adventures.

The experienced pilot aimed at the gap in the line of trees at the end of the field, for the landing on a farm



"Wings are trying to fly backward like those new 100-foot jibs, but he can't keep his wings down!"



## CUT ASSEMBLY TIME BY PREVENTING CORROSION THE PROTEK-SORB WAY!

Davison's Protek-Sorb Silica Gel has shown the producers of implements of modern warfare that time-wasting drying out-pieces are not necessary in order to prevent corrosion during shipment or storage. Protek-Sorb, the moisture absorbent, prevents corrosion by removing the water-moisture within the shipping container. The Protek-Sorb method is the only fundamental way to prevent corrosion, not just after damage caused by moisture. Parts, accessories and supplies arrive at destination clean and ready to use. Assembly lines gain their pace—equipment flows to the battle line in uninterrupted streams. Valuable time is saved at the shipping point and receiving point.

Any product not protected by Protek-Sorb. Even now, engine parts, complete engines, finished tanks and planes are being given Protek-Sorb protection during storage or shipment.

It's time to discard slow methods that waste your time and your customer's time. Use the modern, positive corrosion prevention—Protek-Sorb! Give your customers a service they NEED!

## HOW PROTEK-SORB PREVENTS MOISTURE DAMAGE

Protek-Sorb is a chemically inert, non-toxic granular material that absorbs more than 40% of its weight in water by a physical absorption known as surface adsorption. Placed within the shipping container WITH the product it reduces and holds the relative humidity within the container to far below the danger point. Corrosion, rust, mold and bacterial action cannot exist in its presence.

Applied in corrosion, ready-made cloth bags packed in all right metal containers.

FOR MORE INFORMATION SENT ON REQUEST

# Protek-Sorb

## SILICA GEL

is produced by

**THE DAVISON CHEMICAL CORP.**  
Industrial Sales Department  
BALTIMORE • MARYLAND

AVIATION, April, 1942

# Aviation's Long Tax Road

By SELIG ALTSCHUL

TAX SENSE will receive the lion's share of the attention ahead. The Treasury Department's outline for a new revenue bill is believed to represent the most serious proposal to be presented for consideration. Congress, even at its best, entertains more modest ideas—relatively speaking—on taxation. Yet there were a few far-reaching characteristics surrounding the Treasury's tax measures.

Completely abandoned was the intention for extending excess profits taxes on the basis of a return on invested capital. Such a device would generally search out aircraft companies as reflected in Aviation for November 1941.

A plan for post-war profits was also revealed. Behind the door was a device to reduce the stock of post-war economic shifts.

At the time of any dollar of corporate profits, the concept of which results in its removal to tax beyond perhaps 10 cents, the additional tax on each dollar shall be held by the government in the amount of the corporation and be returned within a limited period after the war, in those cases where it is spent for new and additional capital equipment or otherwise is spent in the additional equipment of labor.

This provision is the subject of a forced loan scheme, in similar to a plan now in operation in England. This recent legislation is of vital importance to corporations in the top excess profits bracket as well as those faced with transitional adjustments after the war. The aircraft leaders are definitely in this category on both counts and will consequently follow this proposal with intense interest.

## PROFIT LIMITS OPPOSED

The Treasury also expressed opposition to suggestions limiting profits on war contracts. Higher excess profits, the Treasury contended, are much more desirable and will replace under profits. This position may be hard to swallow in the aircraft industry as it may provide additional line financing and insured returns to be paid.

In the Treasury proposal the effective top bracket would be raised to 68 percent of corporate income as compared to a possible maximum of 72.4 percent at present. This new top rate, if adopted, could affect a wide majority of the aircraft companies.

At the same time, the Treasury proposed to increase the top rate on the first \$1 million of corporate income to 68 percent. As in the past, while the House Ways and Means Committee may accept new revenue measures, it is the Senate Finance Committee which will be heard to come.

It is becoming increasingly evident that this eye to the future together with a lower level of profits and the need for working capital, all compare to the tax reduction and the return on investment. This is well illustrated by the Douglas Aircraft Company report in 1941 showing net earnings of \$80.29 per share for its fiscal year ended November 30, 1941. The company paid a dividend of only \$5 per share for the period, leaving out that 1941 profits are reported "in excess of what, in the future, the obligations of war-time hazards of war."

It is of interest to note that Douglas, in view of its fiscal year ending November 30, is always one year behind in filing the excess profits return. In other words, results for the past fiscal year were subject to the 1940 tax measure whereas virtually all other aircraft companies, reporting on the calendar year basis, were subject to the 1941 tax law.

Despite numerous reports concerning excessive and inflated pay for American and British, many aircraft and other aircraft plants related to war time reconstructions actually and indirectly were aware that the CAB could not set a ceiling on such payments.

Several in these cases and other cases may be, in the uncertainty of continuing greatly expanded output—largely by the CAB plan that controls the cost and price of aircraft to future air power. This will be treated more fully in a subsequent article.

Several in these cases and other cases may be, in the uncertainty of continuing greatly expanded output—largely by the CAB plan that controls the cost and price of aircraft to future air power. This will be treated more fully in a subsequent article.

## DETERMINE THE IMPACT OF THE TAX BILL

And the chairman of the Senate Committee is known for his firm opposition to keeping an excess profits tax on top corporate profits.

In any event, whatever faces the 1942 tax bill answers, it appears a certainty that industrial earnings for the coming year will fall decidedly short of the 1941 level. In annual sales such a prospect would represent a decided setback towards lower stock prices. However, the

tax bill appears to maintain their occupancy from paying excess profits taxes, they would be hard hit by the new series, schedules. The present 31 percent top tax rate (28 percent normal and 7 percent excess) would be replaced with a new normal tax rate and a special surtax of 16 percent on the first \$25,000 of income and 31 percent on the balance. If enacted, this could make an effective tax rate of virtually 50 percent for many air carriers.

There too it must be pointed out that these new tax schedules may be of considerable interest only if the tax measures reflect to its expected results. It is also recognized that airline earnings are not of the proportions to suggest the effect of the tax reduction. During the years 1936 and 1940, the domestic airlines average aggregate earnings of \$1.1 million (Times in page 22).

Bureau's Stock Analysis			
	1941	1940	1939
Domestic	10.10	12.10	10.10
Foreign	10.10	12.10	10.10
1941	10.10	12.10	10.10
1940	10.10	12.10	10.10
1939	10.10	12.10	10.10
1938	10.10	12.10	10.10



## Security Airster

In three minutes' time, one man can convert the 40 ft. wing span of this plane into a convenient width of 13 ft. 4 in.

AN ITEM of an small, important to operators, who must not storage space or build their own hangars, is the folding wing arrangement on the Security Airster, built by the National Airplane & Motor Co., Los Angeles, Calif.

Powered by a Security 5-5 125 hp engine designed by W. B. Kinner, chief engineer of the company, the Airster is a two place, side-by-side low wing model with dual controls. Top speed is 125 mph at 10,000 ft., and stall speed 30 mph, which would make the ship adaptable to small, rough landing fields. Service ceiling is 15,000 ft. with an absolute ceiling of 20,000 ft. Initial climb rate is 5000 ft. in 3 min., 14,000 ft. in 10 min. and 20,000 ft. in 1 hr. 10 min. Range is 300 mi.

Fuselage construction is of welded chrome molybdenum steel tubing, as are the wing struts, formed integral with the fuselage, and all tail surfaces. A rigid girder effect has been secured in the wings by double bracing all in-

ternal drag members and the positive locking mechanism for the positive folding attachment is standard equipment. The Airster is also equipped with a winging motor mount, permitting easy access to the rear of the engine for routine service operations. Good visibility can be had in all directions from the cockpit, the unobstructed, capsule-shaped enclosure of which slides backwards for entrance or exit. Landing gear is the hydraulic type with retracting landing brakes.

The Security 5-5 engine is a 4-cylinder, 5-cylinder model weighing 325 lb. complete. Aluminum alloy cylinder heads are attached to the special alloy cylinder and held with four through bolts of high tensile steel. Cast aluminum rocker arm boxes are oil tight, with automatically lubricated roller stems. To assure ample cooling, valves are set at a wide angle and are actuated by a single 3/16-in. cam-disk, turning in clockwise rotation and revolving concentric with the shaft. Hinge type cam

### Flying Equipment

followers, rotate the tappet rods of all side thrust, which increases the life of the tappet rod bearings. A variable fixture at the rocker rod construction. This is a steel locked, bolted fixed bearing shell split on the vertical axis of the rod, and locked with dowels.

The crankcase is an aluminum alloy casting built in three pieces. There are two anti-friction roller bearings and one screw type, and a large thrust bearing is externally rolled for better cooling. Dual Sashida sparkers with full automatic spark advance is provided. Contact is supplied to the battery by a Champion generator, of the high output type, the charging rate being automatically regulated. An electric cranking starter may be mounted.

Both the Security Airster and engine were introduced by the American Aircraft Co., Long Beach, Calif., but all assets and manufacturing rights have been taken over by the National Airplane & Motor Co., present producers.

Specifications and performance data on the Airster are:

Span	40 ft.
Wing area	1,100 sq. ft.
Length	20 ft. 11 in.
Height	5 ft. 11 in.
Wing load	19.5 lb. sq. ft.
Empty weight	1,000 lb.
Max. weight	1,400 lb.
Cruising speed	125 mph
Max. speed	140 mph
Alt. ceiling	20,000 ft.
Service ceiling	15,000 ft.
Range	300 mi.
Climbing range	300 mi.

Designed by W. B. Kinner, the Security 5-5 engine features poppet valves and long life.



The Airster fuselage construction is a welded chrome molybdenum steel tubing. Wing struts are integral with the fuselage.

## If you MUST have Stainless!

*We have the capacity to fill your orders promptly*

IF you are building aircraft or aviation equipment vital to the war effort of the United Nations, we can give you prompt shipment of U-S-S Stainless Steel for application where its properties make it the best material.

Long before Pearl Harbor we were acutely conscious of the growing importance of Stainless Steel as a vital necessity in the production of aircraft for war. So our production engineers

wanted no time in preparing to meet the mounting demand. Not only have we increased our capacity, but we have made available the industry's widest range of sizes and shapes in U-S-S Stainless Steel.

This expansion has made us a quick and complete source for this key material. We're "on our toes" to help you get U-S-S Stainless Steel in the air as rapidly and effectively as possible.



## U-S-S STAINLESS STEEL

AMERICAN STEEL & WIRE COMPANY Cleveland, Chicago and New York

CARBIDE-ILLINOIS STEEL CORPORATION, Pittsburgh and Chicago

COLUMBIA STEEL COMPANY New Brunswick

NATIONAL TUBE COMPANY Pittsburgh

Steel Heat Treating Company Chicago Washburn Steelworks Grand Rapids Steel Erectors Inc. New York



# UNITED STATES STEEL

# AVIATION SWINGS INTO ALL-OUT MASS PRODUCTION!

Increased  
tool life  
Higher surface  
finish  
Greater output  
Increased  
accuracy  
Faster grinding  
Less tool  
sharpening  
Longer runs  
between grinds



BORING IN ENGINE CYLINDER — as a cluster machine manufacturing operation as shown here, Texaco Precision Grinding the important factor, increased the life of the boring tool . . . the operator liked the color and the look of the oil.

AVIATION manufacturers are "keeping 'em rolling" so that the boys can "keep 'em flying." Gigantic plants, machine shops, assembly lines . . . specialized machine-tools, high-speed, stream-lined methods are in general use.

The demand for men, machines, methods, that you realize. Personnel among these is our staff of Texaco Engineers specializing in cutting costs who are at your service with help that will increase output, improve quality of work and prolong engine life. The outstanding performance that has made Texaco preferred in the fields listed in the panel has made it preferred also in the metal cutting field.

These Texaco users enjoy many benefits that can also be yours. A Texaco Engineer specializing in cutting costs will gladly cooperate . . . just phone the nearest of more than 2500 Texaco distribution points in the 48 States, or write—

The Texas Company, 135 East 43rd Street, New York, N. Y.



**TEXACO Cutting and Soluble Oils**  
FOR THE AVIATION INDUSTRY

RETURN METAL DRUM PROMPTLY

For getting the best results, use Texaco oils and greases for your needs.

## Producing Maintenance Men

An aviation school trains maintenance and service men for the Air Forces and commercial services

By W. C. EBB

Engineer, Research Aviation School

FOR MANY YEARS, Research Aviation School has been one of the country's outstanding aviation pilot and mechanic schools. Taking stock of its facilities and capabilities for contributing to the nation's war effort, the directors of the school promptly arrived at some sharp-cut decisions as to the reduction of its faculty and plant during the war period.

Recognizing the critical need for well-trained maintenance and service men for the Army, the privately operated military flying schools, and for the commercial aviation operations, the school determined to make an all-out effort to supply these needs efficiently and promptly.

Today, the entire facilities of the school are devoted to the turning out of maintenance and service men. The flying school is completely out of the picture.

Nearly one-half of the school's facilities have been turned over to the exclusive job of training military Army men for maintenance and service duties in the military sponsored bases. The course is conducted by the regular

This is the advanced engine repair shop where certified airplanes that have been damaged are overhauled and repaired for return to service. In many respects, the production line system is simulated, the airplanes moving toward the back of the shop as the various stages of repair are completed.



This is the advanced wing repair department. A damaged wing from a Stearman HS-4 is being dismantled preparatory to rebuilding. All work is done under the supervision of qualified instructors and government inspectors. There is no time lost for the completion of this work, the only objective being quality of work and thoroughness of instructions.



Maintenance and service men may be called upon to do anything from cleaning a spark plug to substituting an airplane. The student is given thorough training in the use and working of motors in a completely equipped model working shop. Here is a student operating a heavy duty grinding machine. This is more than just an exercise, for the part he is working on will go into actual service.

A section of the elementary engine department where students receive instruction and practice in preparing them for the advanced engine overhaul divisions. In the advanced division, the student works on engines of all types in actual service in the Army divisions at the school, the latest types of military power plants are worked on by the trainees.



FOR YOUR ENJOYMENT  
PREF. ALLEN every Sunday night. See your local newspaper for time and station.

You actually get the performance of  
**2 EXTRA Presses with the versatile**

**H-P-M**

# FASTRVERSE TRIPLE-ACTION DEEP METAL DRAWING PRESS

Use it as a single-action, double-action or triple-action press... the job will be done with minimum change-over, set-up and production costs. This versatility has won the H-P-M Fastrverse Triple-Action Deep Metal Drawing Press an important place in today's all-out production of the Nation's aircraft and weapon plants.

**The Hydraulic Press Mfg. Company**  
 Mount Pleasant, Ohio, U.S.A.

Dist. in U.S. by: The Ohio Hydraulic Press and Machine Co., Inc., Cincinnati, Ohio  
 Dist. in Canada by: The Ohio Hydraulic Press and Machine Co., Ltd., Toronto, Ontario



The 300 ton H-P-M Fastrverse triple-action press shown above is drawing 300 ton steel rollers for the Brooklyn B-42 heavy bomber, from 0.01" to 0.001" thick—equivalent 120 psi force! Other parts are shown at the top of the page of metal made on this same machine. Graphic photo below shows a 100 ton, 10" dia. 24" long 24" dia. part.

A group of Army students in the hydraulic laboratory. The apparatus shown in the picture is a hydraulic "winding" designed to demonstrate the operation of an engine's hydro-mechanically operated landing gear, brakes, and flaps.



An Army trainee is learning how to test a hydraulic system on an engine testing machine. The pressure was regulated and rebuilt by the student.

This is a test unit in the advanced engine department for the testing of overhead and radial engines. The pressure of various speeds is observed with the aid of the indicator mounted on the pump.



fully according to Army requirements. Upon completion of the course, the men are ready to take their stations at repair depots throughout the country and on the far-flung fighting fronts.

This curriculum has not been made to the detriment of thorough and complete training of maintenance men to meet the existing requirements of the new aircraft and flying schools. A more efficient allocation of facilities and the addition of more equipment, where necessary, has insured the continuance of the pre-war thoroughness of instruction. In fact, the course has been expanded in scope to more adequately train the student to meet the increasingly difficult task of maintaining military training and commercial aircraft under

the stress of wartime conditions. Prior to the outbreak of war, the principal "field experience" provided the students was the actual servicing of outside aircraft on a regular commercial basis. The only change made for the war was the removal of the aircraft. Under the arrangement, there was no duplication as to time for completion of the work, thus giving the students ample time to do the job thoroughly and well under maintenance inspection. Since the war, many private airplane owners



have an Army student is receiving instruction in the construction, repair and operation of instruments in the instrument laboratory of the Army maintenance and service school.

Technique Army student is receiving instruction in the construction, repair and operation of instruments in the instrument laboratory of the Army maintenance and service school.



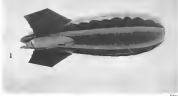


"ATTACK BFE" by John B. Brown

**A SAFE 680 M.P.H.**—It takes exceptional engineering to build an airplane that is safe in a 680 m.p.h. dive. Thrusting downward at this prodigious speed—or crashlanding, outlying, outgassing all contemporaries—the sensational Republic P-47 THUNDERBOLT is the tangible expression of the high engineering skill which planned it to the last detail. Republic Aviation Corporation, Farmingdale, Long Island, N. Y.



**REPUBLIC AVIATION**



One of a considerable number of American barrage balloons guarding military objectives in the Pacific Northwest. These balloons are under Coast Artillery Command.

**I**N THEORY and in general practice, aerial defense in Britain is divided into layers or zones of defined altitudes. The highest zone is defined as that above effective anti-aircraft practice; the next level is continued by the range of anti-aircraft but this zone has a lower limit beneath which it is difficult or impossible for guns to operate, either because of danger or damage to land property, or because of inaccuracy of fire against aircraft moving rapidly at low altitudes. This lower limit is established at around 5,000 feet. It is the function of the balloon barrage to cover the area of the defined position up to that height.

#### AUTO WINCHES USED

The gas bags themselves are designed to carry a cable sufficiently strong, and therefore heavy, to be destructive to the enemy aircraft as required. The present British standard type of balloon has a capacity of 20,000 cu. ft. and is inflated with hydrogen. High altitude types of such larger capacities have been tried—the French Flew balloon, up to 20,000 ft.—but the weight and strength of the cable had to be reduced and it did not possess the necessary destructive power.

The ground equipment for the balloons is carefully designed to provide

standardization, using components easily obtained, replacement and rate of operation by unskilled crews. The tank which carries the wind is a standard heavy Ford chassis with a Ford V8 motor mounted on it to operate the winch, and which is controlled exactly the same way as a car—foot clutch, brake, etc.

#### BALLOON SPACING

The balloon barrage is operated and maintained by a separate R.A.F. Group, but the tactical operation is controlled by Fighter Command, which dictates when the balloons must fly and when they must descend. For any defended area the optimum spacing of balloons is that which provides a continuous barrier between the risk of finding the cables and the closest spacing required to prevent enemy aircraft flying through gaps left in the barrage. (Turn to page 214)

**Military**

# Barrage Balloons Over Land And Sea

By J. I. WADDINGTON  
M.A., A.F.C., A.E.

As Americans now lean seriously to defense against air attack, British experience becomes of more than academic interest. This article outlines the function and success of the barrage balloon as an integral part of the aerial defense system.

British Combines



At right: A unit of London's other barrage balloon system. These units are now being properly equipped with gas containing (using quarters for the crew...). Below: The "bomber" based on the wings of the British bomber. Modified to design to cut the cables of barrage balloons defending British cities. There has been no report on the success of these devices, but the added weight reduces the plane's speed and breaks load capacity.

John B. Brown





# *Announces*

**A NEW FAR REACHING DEVELOPMENT—  
of vital importance—to every management,  
production and traffic official engaged in air-  
plane parts, sub-assembly, or plane manufacture**

♦ ♦ ♦ In cooperation with a nationally known manufacturer making airplane sub-assemblies, we have developed—and have in daily use—a more efficient, safer, and less costly method of handling airplane parts and assemblies than has ever been available before.

This new method of handling is being used for both truck and railroad car shipments . . . and also for handling and temporary storage services within the plant. It speeds the loading

and unloading of parts and sub-assembly shipments. It minimizes, and practically eliminates any possibility of damage during shipment—and permits a maximum load to be handled in minimum space, with much reduced damage.

We cannot publish photographs or details of the savings that are being made with this new development, due to the censorship restrictions prevailing during the war emergency.

The next step, therefore, is up to you— — —

We solicit your prompt and thorough investigation of this new development as aiding our mutual desire to make America stronger—faster.

**MECHANICAL HANDLING SYSTEMS, INC.**

MANUFACTURING ENGINEERS

4670 NANCY AVE. . . . . DETROIT, MICH.

TELEPHONE—TWINBROOK 2-1210





## Airliner Air Conditioning

A solution to the problem of maintaining constant temperatures in transport planes during lay-over periods.

By J. A. FERRIS *Ashbury Beach, Northwest Airlines Inc.*

**M** AINTAINING constant temperatures within the plane while on the ground between arrival and departure times is a problem that has been successfully solved by Ticon Landquist of Northwest Airlines.

Because of weight limitations, it is impossible to have more than a moderate amount of insulation in transport planes. Consequently they absorb a lot of heat in the summer and cool quickly in the winter while on the landing ramp. For passenger comfort, it became necessary to have some sort of arrangement to provide conditioned air within the plane to keep the temperature constant.

To meet this problem, the first of a new type of air conditioning installation was made at the Minneapolis terminal of Northwest Airlines. In the basement of the Administrative Building is a complete air conditioning unit supplying heated water or cold air to the planes on the ramp through an underground duct system down to the terminal at the assigned position of standing planes. The conditioned air is conducted to the plane interior through a flexible air hose drawn from the main hole. Control valves and safety electric switches are located conveniently at the main hole.

In operation, fresh air is drawn

through an automatically opening intake duct and passed through a set of open glass filters to remove dust and impurities. The air is then passed over heating or cooling coils after which it is forced by a fan through a main duct leading to the distribution system.

During the summer, the cooling coil is supplied with a refrigerant (Freon) which lowers the air temperature to 55 deg. F. In the winter, two steam coils are used to heat the air to approximately 140 deg. Steam is supplied through electrically controlled automatic steam valves which open and close as the fan starts and stops.

The air is introduced into the

underground from the air conditioning unit to the 12-in. distribution ducts which branch off at approximately right angles under the building ramp for a distance of 225 ft. in either direction. At 150-ft. intervals along the duct a vertical duct carries the air to the main hole outlet at the open surface.

This installation is an important contribution to the comfort of NWA passengers particularly in the summer of 135 mm. temperatures when the passengers are often in the heat.

Military authorities, too, have shown considerable interest in the installation. The maintaining of uniform temperatures is considered essential in important where conditions of expansion or vital metal parts may seriously damage or impair the efficiency of precision instrument systems.

For those who have a more detailed interest in the installation, there follows a list of the equipment included in the air conditioning unit.

### AIR CONDITIONING UNIT EQUIPMENT

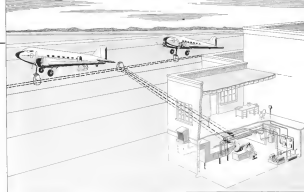
Eighteen-ton capacity Freon condensing unit consisting of a four cylinder compressor and a 35 hp., 220 volt, 60 cycle, 3 phase motor.

Eighteen-ton shell and tube condenser.

Air conditioning cabinet in which are contained the following:

Motor operated water air damper

AVIATION, April, 1949



Schematic diagram of the Northwest Airlines air conditioning system designed to maintain constant temperatures in the planes during lay over periods.

A flexible air hose is drawn from a main hole in the ramp and connected to the duct system in the plane. A direct connection is thus established with the air conditioning unit in the basement of the Administrative Building.

Set of six draw-out type duct hoses.

Screened direct expansion coil, with a face area of 124 sq. ft. having a thermal expansion valve and heat exchanger.

Single row tempering steam coil having a face area of 6.2 sq. ft.

Double row steam heating coil having a face area of 6.2 sq. ft.

With calorimeter type fan delivering approximately 2,500 to 3,000 cfm of air at from 6 to 8 in. H<sub>2</sub>O static pressure.

Fan motor—7½ hp., 220 volt, 60 cycle, 3 phase, drawing fan by "B" belt drive.

Set of controls consisting of the following:

### Performance Specifications

#### Rating Cycle

Rated air flow (standard conditions) 20,000 cfm  
Temperature of air at fan discharge 145 deg. F  
Temperature of air at fan intake 125 deg. F  
Fan static pressure 1.0 in. H<sub>2</sub>O  
Cabinet heat loss outside 1,000 to 1,500 sq. ft. to fan, 500 sq. ft. to fan, 500 sq. ft.

#### Rating Cycle

Rated air flow (standard conditions) 20,000 cfm  
Temperature of air at fan discharge 145 deg. F  
Temperature of air at fan intake 125 deg. F  
Fan static pressure 1.0 in. H<sub>2</sub>O  
Cabinet heat loss outside 1,000 to 1,500 sq. ft. to fan, 500 sq. ft. to fan, 500 sq. ft.

(From the June 1949)



When not in use, the air hose is retracted into the main hole which is covered with the open surface. Note the location of the control switches and safety electric switches.



# Greater PRODUCTION MEETS GREATER DEMAND

With "all-out" for victory, Weatherhead is answering the need of the hour with dependable aircraft accessory equipment. Each airplane part that Weatherhead produces has been engineered not only for performance but also for speed in production to meet the need so essential today. These parts include Dural Tube and Pipe Fittings, and High, Medium and Low Pressure Flexible Hydraulic Hose Assemblies, also Versamatic Selector and Check Valves, Hydraulic Check Valves, and Hydraulic Actuating Cylinders.

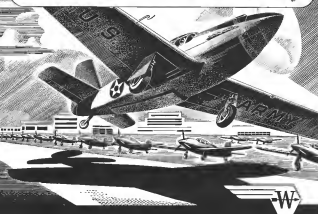
Weatherhead airplane parts are manufactured in Air Corps, Navy or "AF" specifications in regular accepted sizes or standard production.

## THE WEATHERHEAD CO. • AIRPLANE DIVISION

East Coast Office  
New York, N. Y.

Main Office  
Cleveland, Ohio

West Coast Office  
Los Angeles, Calif.



# WEATHERHEAD



Contacted wood trusses of the Northwest Airlines hangar at Fargo, N. D.

## Wood Frame Hangar For Northwest Airlines

Thirteen wood arches, each 182 ft long, form the frame of the new Northwest Airlines hangar at Fargo, N. D. Constructed to accommodate the giant Douglas DC-4, the hangar will have a maximum height of 35 ft in the center. Two-foot spacing between the arches gives the hangar a depth of 120 ft, which may be easily extended whenever necessary.

The arches were designed and fabricated by Cee Structures, Inc., in Wisconsin. They are three-bayed arches, placed up a hill with a rise. Twelve of the 13 trusses have a cross section of 24 ft wide by 27 ft in depth, built up of 4 timbers, each 14x21 in. The thirteenth arch, at each end, is cross-sectioned to serve as a reinforcement of knee and plate for the arch and will support the floor.

The completed half-arches were shipped in two flat racks each a 40-ft after car bottom to take up the over-lay.

Although incorporated with arches of this size, the local contractor had no difficulty in making the installation. Concrete abutments were prepared at the site. These included ball-joint abutments at the rear so that a 75x27-in arch can be withdrawn easily by the 75x21 in arch, if the hangar is ever enlarged.

The base of the arch is fastened into a metal shoe bolted on top of each abutment, and held in place by a long bolt. Let into pre-cut slots in the wood, metal T-iron shear plates, 4 in. in diameter, spread the load from the relatively small bearing area of the bolt and over nearly the entire cross-section of the wood. At the rear, where the ball-joint plate, a hinge effect was desired rather than rigidity, and plate bolts were used.

Dressed and matched, 2x6-in. siding was nailed closely to the arches, which form both the roof and the wall. Six joints were needed for the arch.

The Fargo hangar was built under the supervision of Karl O. Larson, chief engineer of Northwest Airlines, who directed on the strength efficiency, availability, and economy offered by wood construction.

## Air Transport

## Britain's Auxiliary Air Bases

by EARL C. WARREN

The realities of the old adage of not putting all your eggs in one basket is being practiced in good faith by the British. Two or a half dozen large hangars, some the value of three-story apartment houses which has resulted in airports scattered all over the landscape of the British Isles.

Coverly envisaged, these hangars are hard to detect from the higher altitudes at which many planes are forced to fly. Many a bomber has been observed on an auxiliary air station, but the modern art of positive observation looks the observer still in believing that he is still seeing a bomber. The proximity of fields is dictated primarily by the safety considerations, but the value of the land for farming purposes has been weighed.

Contrary to the thought of military men with elaborate administrative headquarters and large barracks, these auxiliary airports, such as simplicity and obscurity. Long paved runways may replace the line recently closed type of which Britain has always boasted. Heavy loads and high speeds, reliability and control necessitate the change. The pavements are either asphalt or concrete.

Depending upon the judgment and equipment of the local contractor, the surface of the pavement is treated to such as to make the immediately adjacent field which may stay a number of times the length of the runway. Planted in deep grass, bamboo and Moss to blend with the surrounding country, it is almost impossible to identify these airports.

Storing the edge of the field well hidden among trees and brush, are what might be called hangars. These consist only of sand bags piled up on three sides to the height of the plane and large enough to shield two ships. Five or six units are distributed well around the field which limits the number of aircraft around at one location.

The British design of roads comply by connecting the ends of the runways to the ground stations by taxi-roads which virtually disintegrate the landing area with a road. The design is so simple, quick and easy to construct, it is almost between the landing area and storage units. The road bag hangars provide sufficient space and equipment to check planes and make minor repairs.

Ground traffic regulations are simple, but on some individuals, the planes turn to the end of the runway and take off. On coming in, the operations are reversed. After the plane lands it continues along the runway to the end where a turn off on the taxi-roads and leads to its designated hangar and then maintenance. Suggested ground movements together with hidden auxiliary hangars with maintain the possibility of pursuing civil from sighting the base. In the event of an attack damage would be localized due to the requirement of the present size and type of construction. Obviously these auxiliary fields are limited in number but by the efficiency of their proximity and land available. They are, however, as simple as just to replace a flying and protective concealment under air conditions.



*Above all else*

Our purpose stands above all else at BEECHCRAFT. We are determined to exceed all War production demands now and hereafter made upon us by our Nation.

BEECH AIRCRAFT CORPORATION  
BEECH AIRPORT WICHITA KANSAS 67207

Copyright © 1942 by Beech Aircraft Corporation, Wichita, Kansas

## Control Tower Operations Recorded On 24-Hour Basis

Equipment installed in the control tower at San Francisco airport by Frank Baker, Inc., permits recording of all incoming and outgoing radio conversations in a continuous fashion in the form of the operator, maintaining a permanent 24-hour log. This in process involves handling a complex, but easy-to-use system, communicating voice messages through the microphone and a check transmitter. Provision has been made for recording voice messages which would be of value in case of an emergency.

The installation consists of two continuous-recording independent recorders, each with a 24-hour tape, functioning consecutively to avoid confusion which would result if a single tape were used. The system is designed to record all messages, including all messages received from the tower, all messages received from the tower, all messages received from the tower, all messages received from the tower.

records relayed and automatically stored in a log. A "complete" record, stored with the records and messages, permits a check of the system by the operator.

When continuous automatic recording is not required, a time-clock mechanism may be switched in to take the records on and off at predetermined times, in which case there is a long-term overlap or duplication in the records that the duplicate lines are available to the other center in the matter of a message. The machine may also be operated manually, or connected to record messages only. A perfectly record feature is provided for playing back automatically heard portions of recorded messages, while the machine continues to record the messages.

Plastic disks used are 12 in. in diameter and record 42 min. of sound on each side, the long playing time enabled a 12-hour operation and reduced the com-

RADIO



ber of disks which must be handled in a day in a moment. Each disk is equipped with a hole upon which the operator may record the date, time and other pertinent data required by the FCC. Disks are stored 40 in the rack in an automatic filing cabinet.

## Light Weight Transmitter-Receiver

Following extensive tests in military service, Radio, Avionics, Ltd., of North Hollywood, California, has announced a 15 lb. weight radio system, claiming performance comparable with more heavier sets.

Known as Model 3001, the system comprises two separate units connected together by means of a cable. One unit contains the transmitter and the receiver and can be installed in any mobile or portable location. The other contains the powerpack and can be located anywhere in the aircraft.

The receiver is a one tube superheterodyne with a stage of tuned radio frequency amplification. Two frequency bands are provided, one for the broadcast elements and the other for communication with the ground and other aircraft. One tuning control and a volume control are on the panel.

Jack boxes located at both ends provide handy connections for microphones, headphones and telegraph keys. A built-in antenna relay permits the use of a single antenna for both reception and transmission.

## Battle-Proof Parts

Manufacturers of aviation radio parts, now fully aware of the fact that components going into ships, land-based for military use must withstand the shock of gunfire, are re-developing to meet this new and severe requirement. One good example of the current trend is found in the design of the International Rectifier Company of Philadelphia.

Before receipt of military notification a new standard message is now in the design of a 15 series sensitive d.c. series made by the General Controls Company of Glendale, California. These tubes are mounted within shielded plastic enclosures which are mounted in a standard rack. The tubes are adjusted by means of the vacuum gaps rather than contact spacing.



B. H. Berlin, manager of San Francisco's airport department, manipulating tower communication controls. New automatic recording and playback equipment appears at the left.









### Weight Engineers Meet in Chicago April 27-29

The Society of Automotive Wheelchair Engineers will hold its second national meeting at the Palmer House Chicago from April 25 through the 28th.

The program is to be attended as follows:

- April 20—Military Projects
- April 28—Accessory Projects
- April 29—General Technical Projects

The SAME is a new but really "important" industrial organization founded on the belief that the future development of almost all depends to a high degree upon the application of research to widest material and to eliminating procedure. By including the leading weight control specialists of the American industry in its membership an interchange of ideas and data on the weight developments is made attainable to the industry.

The colony was organized as a local trade in 1909 in Los Angeles, but since then has striven to be a national organization of impressive stature with chapters throughout the country. The Chicago meeting, under the direction of 1942 Chairman, Donald R. Wilson, should prove to be a milestone in this important work and a definite contribution to the national war effort.

### Engine Parts Plant

**H. A. Woodworth Co.** Paralels Mich., was awarded funds for additional machinery and equipment for production of precision aircraft engine parts. Company has received \$100,000 in advance orders and its employees are working on the 24-hour-a-day 7-day-a-week basis. Woodworth will produce its high production rate in a synthetic process in which it is not possible to use these materials. Woodworth and plant equipment which is under construction for work with a minimum loss of machine time. Two of the three large plants are devoted to manufacturing of parts, with the third used for heat treating and painting.

### First Forging Plant

The first flying pitot in the U. S. operated by aircraftmen exclusively for the aircraft industry is Aircraft Mechanics Inc. of Colorado Springs and FRODO W. McNICHOLS president. Flying pitot tubes will be handled by A-

The new plant which adds a total of 40 tons of alloy steel forgings per month, brings the capacity to 120 tons per month.

## Try For 95,000 Feet

The Rome newspaper, *l'Espresso* in Rome, reported no Italian engineer had a patent will attempt to reach an altitude of 30,000 feet in a stratospheric balloon flight from Mt. San Giuliano in Argentina, according to United Press. Professor F. G. and Chapin, stratospheric experts, limited instruments in the gondola.

### Light Plane Limit

The order from the War Production Agency, L-85, limiting production of light glass under 808 sq. cm. did not restrict use of CPTP and GAF and indicated that ARF and Navy will be using large numbers the NAA caps. A GAF or CPTP member may purchase a glass if it is bought on duty, with the signed agreement that the buyer will remain in NAA for less than 900 sq. of glass in the line of duty to be certified in his log book. Companies orders are expected on maintenance parts and tires.



An overhead conveyor system helps in speed production of the C-46, Curtiss-Wright's new rugged transport. It speeds assembly for the Army Air Corps. More and more of the fuselage is being moved from the spinning factory to final assembly department. It is broken down into 56 major assemblies to speed the production and expedite sub-assembly of parts and accessories.

pel on aircraft which have aluminum ribs and covers more than 18 percent aluminum in airframes, or plane with ribs of other materials and sandwich more than 1 percent aluminum in all

### Unified Hiring Offices

Fifty thousand prizes are expected to be based from the World's largest employment office, which began operations in Los Angeles on March 1 with the backing of the United



Malik built several bridges for his brothers and others from the performing times on an increasingly busy Harlem in Harlem. (The artist, president and general manager, presents his album to his brother who has just completed his last run to City U. - N. Brown, Air Force, and others.)

## IN R.A.F. SERVICE



### New Balloon Patrol

To work out of Lakewood N. J., the Mary has set up the first point standing of a belated paper store. Others will find it and all of her stationers at Elizabeth City N.J. and South Brunswick Mass. who served them on the West Coast.

### Barrage Balloons Used

Barrage balloons are being used to protect military objectives in the Pacific Northwest. The balloons are moored by thin steel cables that would be invisible to enemy pilots but would cause any plane that tried to shoot at them to crash.

The hallways are about 100 feet long with outer skins of two-ply rubber. They present a real hazard to young crabs.



ARE "BUCKING" INTO THE  
JOB OF DEFENDING BRITAIN

**NORTH AMERICAN AVIATION, INC.**







Press Association  
Aviation safety receiving instruction just before being tossed into the air at the Army's War aviation school in the desert near Twenty-Nine Palms, Calif.



William F. War aviation vice president of Aviation Corp. of which General is a director, and P. E. Gorman, division manager, inspect a Lightning "T-30" biplane in a flight experiment. It develops 100 hp. at 2,500 rpm and consumes only 10 pounds of gasoline per hour of cruising. The oil jet engine of this ship motor is usually adapted to C-47 flying.

### Blimps Drafted by Navy

Two Goodyear "Midget" blimp and balloons have been taken over by the U. S. Navy. The Navy has taken over the two blimps and balloons for use in the Pacific. The Navy has taken over the two blimps and balloons for use in the Pacific. The Navy has taken over the two blimps and balloons for use in the Pacific.

### ATA Goes to Washington

For the first time in its 16 years of existence, the Air Transport Association has its headquarters in Washington. The new headquarters is in the new building at 1100 Pennsylvania Avenue, N.W. The new headquarters is in the new building at 1100 Pennsylvania Avenue, N.W. The new headquarters is in the new building at 1100 Pennsylvania Avenue, N.W.

Gen. Archibald H. Macdonald, AUSA, remained in his largest position as the chief of staff of the Air Corps in the role of training Washington.

### Martin Saves Aluminum

Gen. E. Martin reports to the War Production Board that scrap-aluminum property has been in 10 percent of the company's waste since the war. It is expected that Martin will also arrange some 100,000 lb. of waste paper in 1942—paper which otherwise would have been burned.

Martins have been found to recover the higher-grade aluminum and put them back to work without burning. This discovery was made by P. E. Gorman, vice-president in charge of manufacturing. Gorman has found all of the waste material of metal paper under the eyes of several months because it contained much valuable aluminum.

Not in view of the shortage of metal, the method of recovering and using technique which permits less paper from being used.



General "Red" Rodgers stands by the side of the ship. A new bomber takes the station in an emergency when it is launched from an Eastern air base. Note how general sits on his stomach to operate gun.



Parading under difficulties, Navy's PBY amphibious is forced through on fire to open water for launch on its mission to hunt in Pacific. Aerially, Navy's PBY amphibious is forced through on fire to open water for launch on its mission to hunt in Pacific.

### 3 Generals Transferred

Three general officers of the Army Air Force have been ordered transferred to new stations in connection with the expansion of Air Corps training program for War Department roles.

Major General Vernon K. Young has been ordered to report of duty as commanding general of the War College Air Force Training Center with headquarters at Maxwell Field, Calif. He has been assigned to duty in the Office of the Chief of the Air Corps in Washington. Major Gen. Ralph P. Gorman has been ordered to duty as chief of the Air Force Division of the Air Staff and ordered to replace Gen. Young.

United Corporation has produced one more edition of the "New" Manual. United Corporation plans for the production of another number before the war ends. That number made of this later, the company will, in 1942, produce the "New" Manual. That number made of this later, the company will, in 1942, produce the "New" Manual.

*Guaranteed Forgings*

*Laboratory Controlled*

**WYMAN-GORDON**  
WORCESTER, MASS.  
PAUVEY, ILL. DETROIT, MICH.

Have you read  
and acted on  
the  
announcement  
on pages  
158 and 159





Ready  
To  
Fly  
On  
SKF



BUILT BY PRATT & WHITNEY

As one Pratt & Whitney engine after another is hoisted off even-lengthening assembly lines and placed on giant bombers, four parallel planes, speedy fighters, long-range observation planes, and alert interceptors, you'll find SKF Bearings depended upon for reliability. For in today's far-flung outposts of Democracy the dependable performance of airplane engines is vital to Sky Supremacy. Good engines and good bearings always go together.

SKF INDUSTRIES, INC., FRONT ST. & ERIE AVE., PHILA.



**SKF**  
BALL AND ROLLER  
BEARINGS



**BONDS FOR BOMBS!** Back of every action against the enemy is the purchase of Defense Bonds. Each bond you buy strikes a timely blow in your Country's fight for freedom. Buy regularly - every payday.

*Consolidated*  *Aircraft Corporation*  
SAN DIEGO • CALIFORNIA

## TRANSPORT AVIATION

**FAA Maintains Atlantic, Pacific Services  
PANAGRA Adds Fifth Mail Schedule**

[illegible]

preserved by the Chilean navy which have survived two years of warfare.

American and Chinese planes were in the air on the day of the attack and weather of flying checked-out through radio altimeter, hovering from 10,000 to 15,000 feet.

A new air mail service, the RLA Lines, the first owned of South America, is now in operation. It is based in Rio de Janeiro, Brazil, and has routes to Alagoas, avoiding four additional stops with over the 4,000-mile route between Rio and Alagoas.

On Oct 10 the first of the Brazilian Air Force's new jet fighters, the F-47, was delivered. The newest doctrine being used was the "high speed attack" and the F-47's were used to attack the ships in the bay.

The ships were driven on the water shoreward, turned out the stern on the ships and the F-47's were fired off in one hour.

which delayed development in recent years—while at the same time was asked by the President who demanded attainment of one system. They say also that very little further production of equipment can be had till the war ends. That is

will use a pair of two's there to track pilots and get into operation.

Quick installations are under contract with ITAT and the same company has bid on the most. The Indianapolis station has operated for months experimentally, and the one at Washington is two-thirds completed.

### Safety Award Winners

Certificates of award for safety teams presented at a luncheon March 5 to fellow the 1982 annual convention of the National Safety Council. Awards are as follows: Pasadena, 20,200,120 pounds and 1,000,000 miles in 24 weeks accident. Workers Division of Pull American Airways Express, 30,440,000 pounds

Joined safely award. Not commencing 100-000,000 pounds per mile. Without a constant in case liability for 1991.

## Airlines Can Use AAF Alternate Ports

Commercial airlines are permitted to use Air Force bases in alternate ports when weather or other emergency conditions prevail, making scheduled airline terminal ports unsafe, under authority of an Army order recently issued.

DOI: 10.1002/for

The Division of Industry Operations issued Interpretation No. 1 of Preference Rating Order F-62, making it clear that the rating for ab-

A certificate of safe operation was awarded to Northwest Airlines, for safe operation during 1944. Northwest has operated more than 95 million passenger miles during its entire operating history without a passenger fatality.

These items included communications equipment ground station leased and essential office facilities as well as parts of planes. Some suppliers had been returning deliveries to airlines to whom the benefit of the order had been extended, if any material was essential to flight.

### Transport Gets A-1-J On Maintenance Parts

Washington (American Bureau)—Further evidence of the utmost importance to combat of the war is the War Production Board's issuance of preference rating on operations and maintenance materials. Items A-3 to A-13, the A-3 rating being the highest, were issued Sept. 1-15, 1941. The A-3 rating was ordered in an amendment to P-47 by J. B. Knowlton, director of Industrial Operations.

Other priorities of P-47 remain in effect, and are being reappraised by the higher rating. About 7,000 a copy of the amendment to each supplier to whom the original order was furnished. The rating covers materials necessary for new airplanes and for upkeep of planes and engines.

than 25 percent of the rest of "banking" during that period. Company stated its opinion that neither the address, singly or as a body, or the CRA had effectively challenged the instrument lending system which would have provided many more jobs to be made.

The authority's officials said they are sympathetic with the address in CRA matter. They point to the lack of conservativeness



Harry's brand new (to the girl in question) Volvo R. D. Green, 40-year-old New York girl, drives Chrysler's landings and leaves by radio on LaSalle's floor.

### No Instrument Landing Till After the War

Eastern Air Lines recently called attention to a loss of \$1,600,000 handed back to its stranded passengers at the January 1968 Eastern trial. This amount was not paid

### TWA Trains Women

Transcontinental & Western Air, Inc. has started a special school at its Kansas City base to train young women to passenger agents to replace those called to service. Women already in their employ are selected first to fill in behind absentees, but that may not replace the experience needed and unloading of planes. TWA also drops the requirement that a woman must be a registered nurse.

Service Insignias Used  
on WM Timetables

Western. All Lines remain public interest in U.S. Armed Forces' service margins: the margin decreased to new lows while cover was in decline covering the Army, Navy, Marines and Air Force. The very strongest in sequence rank, and breadth of service.

*In these times especially . . .*

**Franklin**

**Plus SERVICE**

is appreciated More than Ever

good product and fine service company with which to do business. The service I have experienced and the way they work makes me a regular customer.

W. L. Scott, Jr.

Today, periodic engine check-up and overhaul becomes increasingly important as planes and parts are called upon to do heavier C.P.T. and C.A.P. duty. But extended demands on Franklin service facilities are being more than met, in traditional Franklin style.

Franklin service is fast, economical and exact. Franklin service stations, strategically located throughout the hemisphere, have the parts and equipment to serve you quickly with emergency overhaul or parts replacement. Franklin design, standardized to provide interchangeability of parts, makes for ready availability of parts and easy replacement.

And when factory overhaul becomes necessary, you can bank on Franklin's 42 years of air-cooled engine experience to give you the same speed and attention promised by Pilot Owner Harley Scott.

Write for the location of your nearest Franklin Service Station.

**Franklin**

**Aircooled MOTORS CORP.**

**HARLEY E. SCOTT, Aircooled**  
Engineer, owner of a Franklin-powered Piper Cub, says nothing is better than the Franklin plane, ground or water cooled. One Franklin means







## Buccaneer Base



**M**ORE than a century ago a hardy band of immigrants, led by John Lofgren, stood with the ragged army of Andrew Jackson on New Orleans to win a battle for the existence of the young republic. Today a modern re-enactor, the far-ranging Barefoot Bandmaster Dave Brewer, is playing an important role in another fight against aggression. These clock, swift and powerful glances, now in production, will soon be carried under the battle line of the United States Navy, will agitate the imagination and stirring force of our ever-growing fleet. Stalling off the line is increasing numbers, today's Bandmaster will help Americans and his allies achieve their alignment goal—an enduring memory of the day.

Brewster

FOR LASTING MASTERY OF THE AIR

Tyler Aircraft Corp. collected \$10,000,000 of its revenue from contracts with the United States Navy in 1941 through its desire to avoid excess profits resulting from an extraordinary volume of war production. With one exception all contracts of the company are on a fixed-price basis. A reserve of \$10,000,000 also was set aside in 1941 to meet future expense increases in "going dry" of war production later on.

Several other aircraft manufacturers have voluntarily agreed to limit production of military aircraft to 10% of their 1964 production levels. The government, which largely can control military aircraft production, has not taken such steps. Douglas Aircraft, most of whose business will be in military aircraft, has voluntarily reduced its 1964 production to 10% of its 1963 level. The new law also calls for a 10% reduction in the production of all other aircraft. The new law also calls for a 10% reduction in the production of all other aircraft.

Rayne Whelan, president of United Aircraft, in his 1945 report to shareholders gave statistics to show how rapidly foreign contracts of his company and worldwide sales of all the aircraft industry are being completed and operations revived in America. He was quoted as saying: "United Aircraft shipments last year were 50 percent for the account of the United States Government as against 30 percent in 1940. This year it is estimated the proportion going to the government will reach 80 to 90 percent. Production of aircraft is being accelerated to five percent more per year, against seven percent in 1940, and 'industrial' for 1945.

\* \* \* By RAYMOND HOADLEY \* \* \*

[illegible]

\*\*\*\*\*

for a further substantial increase in the rate of profit is due to the government," says the report.

**John Auerall Co.,** San Diego, Calif., paid a 5% per share dividend on March 15, to all

domestic chairman of the board in a statement following his election. Mr. Broeck said that the number of Brenda employees had increased from 10,000 to 40,000 in three years and would reach up to 60,000 or more by 1946. In the same period Brenda had accumulated payments of 300 new submersible tractors (dredgers). Mr. Broeck holds about 20 percent of the outstanding stock of The Brenda company.

**Douglas Brown**, chief financial officer for the company, said that the company's earnings for the year ended November 30, 1992, were triple those of the preceding year while charges also went up to a new high. **Donald W. Douglas**, president, explained in the report that 80 percent of the \$20m profit on each share of stock came from sales to foreign governments and added that the "old definition of profit as long-life benefits" given was below the industry standard, which makes earnings an added reason for owning the nation's

Mark of one of the airplanes figured in the largest one-way mail offering ever made in Wall Street last month when a flock of 50,000 shares of American Airlines, involving a total of \$107,072,000, was being priced at \$44.50 a share, was sold in a single day. The commission alone amounted to more than \$120,000. The offering was made by Edward & Co., Lehman Bros., and associates.

**Exxon Aeronautical Co.**, San Diego, Calif., advised that the company's 1964 gross sales for the first nine months of the year ended at \$100 million. The company's 1964 gross sales for the first nine months of the year ended at \$100 million. The company's 1964 gross sales for the first nine months of the year ended at \$100 million.

Some unimproving data on the future of our travel who supplied Chicago business of a recent luncheon by W. A. Fox Lewis, president of United Air Lines. Fox Lewis predicts that the present 36 airlines in the United States would be consolidated into six or seven after the war by mergers and other means. He added that small lines would have difficulty.

Demand Forecasts Exports		Profit Per Unit		Total	
Per Month		Per Unit		Total	
1991	1990	1991	1990	1991	1990
1,000,000	1,000,000	\$1.00	\$0.90	\$1,000,000	\$900,000
2,000,000	2,000,000	\$1.00	\$0.90	\$2,000,000	\$1,800,000
3,000,000	3,000,000	\$1.00	\$0.90	\$3,000,000	\$2,700,000
4,000,000	4,000,000	\$1.00	\$0.90	\$4,000,000	\$3,600,000
5,000,000	5,000,000	\$1.00	\$0.90	\$5,000,000	\$4,500,000
6,000,000	6,000,000	\$1.00	\$0.90	\$6,000,000	\$5,400,000
7,000,000	7,000,000	\$1.00	\$0.90	\$7,000,000	\$6,300,000
8,000,000	8,000,000	\$1.00	\$0.90	\$8,000,000	\$7,200,000
9,000,000	9,000,000	\$1.00	\$0.90	\$9,000,000	\$8,100,000
10,000,000	10,000,000	\$1.00	\$0.90	\$10,000,000	\$9,000,000
11,000,000	11,000,000	\$1.00	\$0.90	\$11,000,000	\$9,900,000
12,000,000	12,000,000	\$1.00	\$0.90	\$12,000,000	\$10,800,000
13,000,000	13,000,000	\$1.00	\$0.90	\$13,000,000	\$11,700,000
14,000,000	14,000,000	\$1.00	\$0.90	\$14,000,000	\$12,600,000
15,000,000	15,000,000	\$1.00	\$0.90	\$15,000,000	\$13,500,000
16,000,000	16,000,000	\$1.00	\$0.90	\$16,000,000	\$14,400,000
17,000,000	17,000,000	\$1.00	\$0.90	\$17,000,000	\$15,300,000
18,000,000	18,000,000	\$1.00	\$0.90	\$18,000,000	\$16,200,000
19,000,000	19,000,000	\$1.00	\$0.90	\$19,000,000	\$17,100,000
20,000,000	20,000,000	\$1.00	\$0.90	\$20,000,000	\$18,000,000

[illegible]







## Healthy Workers

(Continued from page 56)

justify the effort and low on physical fitness and no industrial profession is now being made at the Lockheed Aircraft Corporation plant in warrenton, Ore. term. Lockheed has issued every part of its magazine for a marriage study for women, of the Committee on Marriage in Industry of the National Research Council. Publishing the first, a preliminary study of workers' data is being made. Now in progress, it already provides convincing evidence that "workers don't eat right." It's been found, so far, that 40 percent are not eating enough Vitamin A—the vitamin which helps keep the skin and—30 percent don't get sufficient B, which gives them the "anti-fatigue" stamina for months—and 30 percent lack Vitamin C.

Evidence to determine how these dietary imbalances affect production will be gathered over a two-year period. One of 1,000 workers participating in the experiment, 500 will be given daily capsules of vitamins and minerals. Medical histories, check-ups and work output records will be carefully kept.

If, as doctors expect, the new recurring vitamins reduce heart, health and efficiency (that there are positive vitamins, vitamins will be offered to hire themselves who will plus nutritional balanced meals for workers in company canteens. They will direct educational programs for workers and workers' wives. In Coahuila parkways have distributed leaflets, and in one plant had

a "nutrition quiz" meeting for workers. A test program for teaching factory workers' wives how to serve proper food to their menfolk is now being planned by the Industrial Council of the National Association of Women Workers. Have vitamins, mineral proteins, anti-fatigue films, and lectures on health subjects also be advised.

### HIGH COST OF COLES

To a study of "acid diseases" it is hoped vitamins as well as minerals and other essential food elements will be supplied, vitaminically and economically through food. Authorities believe plant and minerals will, according, be incorporated in the workers' diet to make them able to combat general ill-health, which makes most workers. Many times more hours, but that the industrial cost—specifically, about 150,000,000 work hours. Processed which might have any effect on a consumer, these present industry with a bill for \$400,000,000 each year.

For specific distribution, authorities consider a widespread use of vitamin concentrates to supplement the diet. Such a supplement, proving prices left, would be some parts in the vitamin industry, might be expected, covering Vitamin C. Investigations have found that after treatment with Vitamin C workers who had shown marked symptoms of lead poisoning exhibit a striking gain in "finger, chest, and blood pressure color of skin and ability to sleep." The massive administration of 50 milligrams of Vitamin C was effective recommended. Other investigations have shown, however, that, as not all tablets in workers' respect to green from deposits building paper cups. A

vitamin capsule is placed in each cup, and the cup is instantly disposed of after use.

The need for proper feeding facilities has been emphasized by Britain's Labor Minister, Ernest Brown. After a long study of American he said (Washington Post) one of its essential causes is "the entire feeding arrangements in the works." Because many American workers manufacturing plants are now, workers' efforts have been especially well able to forestall such complaints. Similarly, modern and excellent feeding practices and equipment are being provided. Many studies have shown that supplemented feedings, consisting of rich drinks at a work and between work, have a positive effect.

### FEEDING UNITS

To provide these "vitaminous drinks," as well as regular lunches, mobile feeding units are widely used in plants. Through the use of paper cups and containers with such units, a variety of hot and cold beverages made can be easily and quickly dispensed to workers. Caddies or cradles in a stainless steel insulated tank and designed to order in automatic press cups. With a control in the less expensive press cup. Such bottles used to serve hot soup, chili, baked beans, spaghetti and macaroni are heated right as paper containers in a central heater and carried in a hot insulated compartment on the unit. The food is then slowly eaten from the container in which it is heated. Good-for-you discounts, such as Tappan, Brown Bells and Ideal Appliances also have the credit in paper containers or napkins used and used in their use for "vitamin" by increasing antiseptic hygiene symptoms of food.

Paper cups and containers, much studied on these reasons, also help reduce. Each worker is entitled to having his food served in a sanitary cup or container which has been used by no one else and which is discarded when he is through with it. Washing of workers as the cups move through the plant, as well as during service of food is characterized as important point since many workers are adversely affected by stomach or intestinal upset. The dangers of accidents or damage from bottles or glasses in the production area.

### ROLLING RITCHEM SAVES TIME

In one U.S. aircraft plant, this type of player are not exclusively from rolling machines and in others, rollers are operated with vehicle rolls among employees in various parts of the plant. These rollers, thereby are instead of being fed in regular hours and without loss of time in getting to and returning from eating places. In

## WHEN MINUTES COUNT

*Catalin*  
SAVES DAYS



**M**ANY an industrial plant is being turned out from stock Catalin... On regular machine shop equipment... At a tremendous saving in time! From the thousands of standard castings on hand, hundreds are being adapted to the imperative needs of the moment in order that days, and weeks of delay be saved for production's sake. As it saves... Catalin also saves its physical forces has qualified it to do a million. It is strong, chemically resistant, non-flammable and practically non-winter-embrittle. It even special changes, regardless of size or thickness, can be turned up for and out in front of the starting time required for molding. Of all plastic materials, Catalin, therefore offers most to those who are pressed in production. In addition, it will travel any of Catalin's factories in the field and ready to assist on sub-contractors to busy manufacturers. Therefore, whether your problem is one of materials or production, and if the effort is essential to maintain delivery, contact Catalin!

CATALIN CORPORATION • ONE PARK AVENUE • NEW YORK, N.Y.

CAT PHONOLIC 8000 • POLYESTER MOLDING COMPOUND  
MELANGE AND PHONOLIC 10000 RESIN



## NEW BOOKLET... MANUAL NO. 44... Years for the Asking

A complete course of plastic information brought up to date in 44 pages... includes illustrated details fabricating techniques and equipment, casting methods, finished data and analysis and plastic property charts. Write for your copy today.



Workers speed aircraft production. A worker at the Lockheed aircraft plant gets his daily ration of all-important vitamins.

## Watch Northrop



## NORDIC NORTHROPS . . .

These are veterans of the skies above the sea—Northrop XB-45's. For many months these Northrops piloted by valiant Vikings of the Norwegian Naval Air Force have been tracking, attacking, sinking enemy raiders—helping maintain the vital life lines of the

democracy—struggling the plight of Norway. Yet these death-dealing Patrol Bombers, famed military airplanes in the world, are but forerunners of a steady, ever-increasing stream of faster, more powerful Northrop air fighters already in production and in development.



NORTHROP AIRCRAFT, INC. • NORTHROP FIELD, RANDOLPH, CALIFORNIA, U.S.A. • ORLE "NORTHROP"

one plant which has eight outdoor testing plants, serviced by customers, each of 12,000 workers is served a two-minute work in an eating canteen. Vase that stored, the investigation has estimated, amounts to 250 work days a year. Where there are automatic paper service is also necessary work, but it costs the highest military standards, that allowing production to workers from satisfaction that might be speeded by inadequately washed glasses. It also eliminates dirt working at a time when labor, therefore, and machine replacement parts are scarce. The experience of the Los Angeles General Hospital is noteworthy in this respect. Having switched to paper for serving food and drink to its 2,000 patients, it was able to release 15 kitchen helpers for war industry jobs.

Other factors influencing worker morale and health include the properly controlled physical environment. At Lockheed, where new employees are taken as at the rate of 2,000 a month, every applicant is given a complete physical examination not for the purpose of excluding applicants from work but to fit each man to his job. The conception of the examination differs with that recommended by the Committee on Healthful Working Conditions of the National Association of Manufacturers which advises: "Examinations should determine the individual's fitness for the job and permit placement of applicant or employee on work which he can perform without harm to himself as he follows employment."

### GOOD SURROUNDINGS HELP MORALE

Desired surroundings are vitally important for morale as well as health. Studies show improper lighting and work conditions affect a man's ability to work. Authorities unanimously favor abolition of such potential disease carriers as excessive drinking glasses and advise that all drinking fountains should be equipped with dispensers of paper cups. Water spilling in a worker's hair is not only aesthetically displeasing, especially to women, but recent studies at the University of Pennsylvania have shown that spilling water may carry bacteria to lower extremities. With a glass-and-cup attachment, and a dispenser of paper cups, a better solution may be easily conceived to provide a sanitary drink.

Plant managers have found adequate workroom shelter, with plenty of hot water and better rooms for men accepted in heavy work, are possible. One manager whose plant offers such facilities observes significantly, "Few men feel grumpy after a good shower." Extra meals is a necessity. In one California plant where aircraft parts are manufactured, meals it offered by employees. Promptly at 5 p.m. the music starts in

an automatic phonograph and is distributed by amplifiers throughout the plant. It continues 15 days with exception of the lunch hour. Scientific investigation, which proves that men actually work in harmony with certain rhythms, suggest this plant's success.

### RECREATION FACILITIES IMPORTANT

Finally there is recreation. Aircraft plants, when viewed on the outside of some might follow the example of the American Rolling Mill Company at Middletown, Ohio, which, on adjacent property, developed athletic fields, a golf, and a golf course. The latter for recreation, especially by the young, might weaken in aircraft plants, can hardly be measured as such at the fact that these youngsters have, of these own villages, toward the Defense War Relocation Camp in southern California. Composed of 10,000 workers who left from 4 p.m. to midnight, it holds "swing-shift luncheon" after lunching in the Glendale (California) Creek Amphitheater. But plant employees have noticed them to take these jobs, though the hours kept depress them of normal social activities. Privileges at an area plant for dancing, bowling and motion pictures will make not only good but enthusiastic workers.

Both the Army and Navy have recognized the importance of morale in their industrial plants and have followed with action. The Navy gives "E" awards to encourage plants which produce on schedule and set reference considered to be giving "Grouping jobs." A company with plenty of good level ground, marks the presentation of the award to a plant. The Army has appointed a special group to handle industrial morale work. Key men in its policy is to make workers feel that victory for the United States depends on their doing their jobs well. (See From the Forge to the Factory, *Aviation*, February, 1942.)

### HEALTH PROGRAM MERITS

Initiatives launched on all-out war programs are already pending over abundant research and collecting. "Something must be done." That "something" can be accomplished now it is realized that the proper functioning of manpower depends upon good health and morale. The steps by which labor action can be reduced then become apparent. The answer may be found in a general health program which provides workers with such comparatively simple means as exercise items, single service paper cups and containers to protect against infection, maintain physical cleanliness, and health education. Such a program, designed to reduce illness, consequently means less time and money in health costs.

## America At War

(Continued from page 12)

product that there'll be a hot time over most of those towns this spring.

The British ranted in a grim sample of what one can be done at Billmeyer near Paris. Laying waste the great Renault motor and glass works, and taking an enormous number of persons. You can consider also, if it's so easy to destroy factories, there are still any in Europe. The answer, coming from this direction, seems to be a surprise. The Allies didn't expect it, because the Allies have tried to keep from offending France. Since Europe has so many important cities to defend, against Britain's air, or surprise any work against the Nazis again and again. Supervisors to the air by either side, would soon plumb the most devastating result as that at Billmeyer.

### HEAVY AIR ATTACKS TO COME

It did seem unlikely, with the Russians getting closer and a better looking map of Germany, that the Germans will ever again muster enough air power to repel England again as they did before. Chances are that Germany will be badly attacked by air from both fronts this summer, and she will have to rely on her forces accordingly. Incidentally the raid on Billmeyer was a helpslapping job. The plane went down and lost their eyes right on the spot. This apparently was true also of the American B-29's last destructive attack on Jap shipping, with steel bombs kipped in 9-10's.

### FINAL WORD ON KELLY

The release of a Jap bulleting by Col. Kelly's air crew is old news, but it's not too late to clear up a popular misunderstanding of it. Most people thought Kelly was a torpedo plane, against the ship's life. He didn't. A member of the crew has been permitted to tell the story. The crew of eight or ten, in a four-engine bomber, spotted the ship a short flight off Lamm, and, after landing, they over, decided to let go on her. They made a run from a low altitude, seemingly about 10,000 feet, and dropped all three of their big bombs at once. One of them hit the deck and the other two hit the superstructure. It was a bombier's dream. Then some Jap paratroopers shot the bomber up. It went into a spin of cloud, disintegrating. Kelly ordered his crew out, staying with his ship to the last. Apparently he was unable to get clear due to the violent movements of the crippled plane.



# BOLTS

## FROM THE BLUE

Each hour of production hastens the day when America's fighting planes, superior in numbers on every front, will strike like bolts from the blue.

One of the many factors which give American planes an "edge" in altitude, maneuverability and reliability is the dependable performance of Delco explosion-resistant fuel pump motors. Conforming to latest military requirements, these lightweight motors integrated the flow of fuel in starting, transfer and booster duty.

Delco Products is proud to serve the aircraft industry as a manufacturer of fuel pump motors and of other aircraft equipment and aircraft material.




# DELCO MOTORS

Division of General Motors Corporation

## Streets for P-38 (Continued from page 17)

vide the proper work angle, to secure the best flow of the molten material.

### FOURTEEN OPERATIONS IN A SINGLE SETTING

The cylinder diameters are based on a special M. P. & John Herman Co. machine, in which the work is held stationary and the tool head is moved hydraulically to feed the boring bar through the work. Four different diameters are bored including the air chamber, oil chamber, piston bore and lower packing gland recess which is later threaded. The cylinder is clamped in three places for maximum rigidity, and the boring bar is pushed through the work by a tail-stock backing, the bar first being passed completely through the work before any cutting starts. A roughing cut of about 1 in. is first taken and a finishing cut of about 16 in. follows. Cutting oil is fed to the tool through the boring bar at the rate of about 40 gpm. A total of 14 operations is performed while the work is held in this set-up. Following the boring these sets of internal threads are tapped for upper and lower plug and lower oil-inlet slots.

### HEAT TREATMENT AND ASSEMBLY

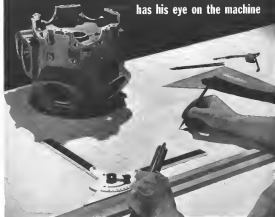
The cylinder is now ready for heat treatment. This treatment, as with other operations, is controlled with great care and precision in order to secure a maximum strength in all cylinders on 100,000 psi. Two groups of dynamic testers are used, one for bursting, the other for driving. Each one simulates the actual in-service experience through use of Leeds & Northrup Macmaster recording controllers. Material gas is used to provide the controlled atmosphere and a large head is used while transferring the pressure from the furnace to the measuring tank to reduce cooling effect. During tempering the cylinder is exposed to a bath of a mixture of 38 to 42 Rockwell C, and all machining, except rough boring and turning and internal threading is done at that hardness.

The sections of the cylinder are then cleaned by sand-blasting following which the assembly is step-by-step inspected.

There follows a final operation to finish the hole facing for length and to turn a portion of the cylinder for steady runs for grinding and boring. The piston recess and packing gland recess are then bored following which all threads are tapped in place.

Two plugs are threaded and -weld-

... because the man on the board  
has his eye on the machine



HECKER tool designers think in terms of the man on the machine. They can do this because many of the tools, jigs and fixtures they design go to work right here in the HECKER plant. We're fabricators of airplane parts, as well as tool designers and builders.

This makes the HECKER-designed tool jig or fixture a better product, whatever it goes to work. The bugs are taken out while the job is still on paper. That's also why some of the country's biggest aircraft and sub-production plants are

using HECKER tooling service for faster results from their machines.

HECKER tool jigs and fixtures make money for your plant, on your production. They'll do the same for you at your plant. Send your problems to A. W. Hecker, 1078 East 66th Street, Cleveland, Ohio.

A-W

# HECKER

DESIGNING AND BUILDING OF TOOL, JIG AND FIXTURE MANUFACTURED BY AIRCRAFT PARTS

assembled into the main cylinder. The upper plug seals the air chamber, while the lower serves as an outlet plug. Both are first treated then screwed into place, after which the cylinder adjacent to the plug is heated from the outside to a temperature sufficient to seal the weld and fire is allowed to cool.

The packing gland chamber is then ground followed by the grinding of three external surfaces to produce specified wall thicknesses. After straightening the three sets of jaws previously welded in position in non-rotated condition, the lathe hole and the upper lat-

er hole in the cylinder are drilled. The radius is then milled on the torque test lug and the external thread on the lower end of the tube is ground. The principal machining operations are completed by finish boring the upper cylinder end for the Welch plug. After burning and straightening the screw member, the assembly is ready for final inspection.

#### INSPECTION ROUTINE

Frequent inspections are made throughout the manufacturing process. The inspection has been set on a pro-

cedure basis without sacrificing the necessary protection. For all dimensional checks that is accomplished through the help of special gauges and fixtures which eliminate hand set-ups and make the operation semi-automatic.

Magnifying equipment of the most modern type permits rapid examination of the material thickness in several critical areas. All welds are subject to magnification. A total of eight different magnifying examinations are made on the cylinder start in the course of its manufacture. All batches of steel are subjected to extensive metallurgical analysis. Each set of parts that is heat treated carries a test specimen which is then checked for strength and hardness as a guarantee that the heat treatment is in specification.

After the final inspection, the outside diameter of the cylinder is extremely plated except the upper end, which fits into the torque test fixture. The interior chambers are cleaned and heated and the receptacles created on and the unit finally assembled for packing and shipping. Before packing, however, the assembly is filled and tested for leaks and run in an endurance process.

As indicated before, these check strains are of exceptional design and of simplified type. We believe, however, that much of the credit for the reliable performance and reliability in service must go to the finished case with which they are manufactured.

#### Propeller Design

(Continued from page 11)

water ground and finish condition. The durability of wing rails is mostly determined on test flights of the finished model.

#### FUNCTIONAL TEST FLIGHTS

On most installations it is desirable to conduct functional test flights to check general operation, high pitch settings, feather angles, etc. After such tests have been made and the requirements for acceptance have been met it can then be said the propeller design has been completed.

The foregoing is a general description meant to outline the high points in an intricate propeller design and modification with complete design. There are many additional details, many of them minor, which successfully have been worked, but it is hoped that the importance of considering the work in propeller in the early stages, and throughout the complete design, has clearly been defined.



## AIR-MAZE AIR FILTERS HAVE HELPED TO "KEEP 'EM FLYING" FOR NEARLY 16 YEARS!

Hundreds of photos similar to Jack Roberts' "Barnstormer," shown above, offer strong testimony to the superior performance of Air-Maze equipment in making aircraft engines more dependable and more durable.

Continuously, since 1926, Air-Maze has worked closely with aviation engineers in developing positive air filter protection against destructive dust and grit. As engine speeds increased and revolutions decreased, the need for the accurate and precise efficiency of AIR-MAZE Air Filters became greatly recognized. Today, Air-Maze is satisfied equipment is among aircraft... and fully meets the U. S. Army and Navy specifications.

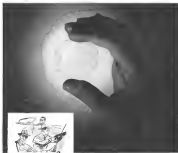
The long and specialized experience of Air-Maze engineers is at your constant service in solving your air filtering problems. Write us now, without obligation.

#### AIR-MAZE CORPORATION

1800 Belmont Avenue • Cleveland, Ohio

# AIR-MAZE

DEPENDABLE AIR FILTERS FOR EVERY APPLICATION



#### BAUSCH & LOMB IS BUILT SCIENTIFIC GLASS PRODUCTION

It was here that Bausch & Lomb first began to produce optical glass. From the earliest days of its existence, Bausch & Lomb has been producing optical glass of the highest quality. This is because you can't get optical glass of the highest quality unless you have the right equipment and the right people. Bausch & Lomb has both. That's why Bausch & Lomb is the world's largest producer of optical glass. And that's why Bausch & Lomb is the world's largest producer of optical glass.

#### BAUSCH & LOMB OPTICAL COMPANY

ROCHESTER, N. Y. • BETHLEHEM, PA.

AN AMERICAN PATENT, TRADEMARK, SERVICE, DESIGN, AND INVENTION. FOR RADIUM, DEFENSE, EDUCATION, RESEARCH, INDUSTRY AND FLIGHT. CONSULTANTS.



aircraft which actually are tested with a chamber.

(3) After driving parts are assembled for "overheating" which may be done separately within three days, with subsequent air treatment.

Present production capacity is expected to be tripled or quadrupled with the installation of new standard size tanks of large capacity. Overhead hoisting handling the parts will be equipped with automatic timing devices to insure accurate control of the process.

Even though this new method for clearing Alclad has been an important

factor in Westinghouse' production progress, standard standard conditions under which to carry additional improvements.

### Strength Analysis

(Continued from page 89)

2x7371m14742 ft. Since this last is greater than the last which may be applied to the joint without exceeding the allowable load on both sections 4-A and 4-B, it can be seen that section C-C is

the last stressed of the three sections. An inspection of all 'at the results obtained in the preceding computations indicates that the total bearing strength of the rivets is less than total bearing strength and also less than the total tensile strength of the 003 plates. The tensile strength of the 003 plates can be determined in a manner similar to that used in the analysis of the shearing plates. However, it is assumed for this point, that the strength of the two 003 plates at all sections is satisfactory. The only remaining factor to be considered is the tear-out strength of the various plates making up the joint. If an edge distance of two diameters is maintained on all rivets in the driving process, it can safely be assumed that the rivets will not fail in this manner. Consequently, it can be concluded that in this particular example the strength of the joint is determined by the total shear strength of the rivets, that is, shearing of the rivets is the critical condition.

### Side Slips

(Continued from page 107)

the student, in the near past, generally occurred. To this unique characteristic we can credit the continuing success of many of our most prominent engineers and pilots.

It was hard to see through the yellowed and scratched windows, the darkness of wings and fuselage was not visible; half of the spools were out of the wheels, the wings were a mass of straps, wires and shrapnel, the ceiling had more patches than a quilt; mud, most green, on the tail section.

As graduation day nears, hundreds of students are made, and they fly and test, and sometimes, and sometimes, and the elements had provided them with a lot for all. We hear their day is done, and so we say but and farewell, Jerry—you were a good graduate of the amazing section of the school.

■ **CONGRATULATIONS TO THE "DEFENSE RESEARCH ACT,"** passed by Congress. Flight strips for aerial tests, 300 to 800 ft. wide and 100 to 2000 feet long are proposed to be built alongside of selected sections of highways. To the Act refers to them as "flight strips," which is something if it was sponsored by Cope. Now let us see if the other "highway" opens. Co-possibly the sponsor was the young lady in California who recently achieved some publicity from her belief of not having while waiting her place.

# Business not as usual

Business is definitely not as usual at the Ryan School of Aeronautics. The entire faculty of the school in pilot training, have been turned over to the Army Air Corps. For the duration, only Army aviation cadets will be trained.



**TWO MILLION MORE MAY FLY**

**NOW!** The War Department has made two million more strong men eligible for Air Corps Cadet Training. Cadets training in longer necessary simplified curriculum — even married men with no dependents may join. If you are between 18 and 30 your application will be accepted now at the nearest U. S. Army Recruiting office. Become a flying officer in the Army Air Corps. Write now.



**RYAN**  
SCHOOL OF AERONAUTICS  
Dunsmuir Field - San Diego, Calif.

CONTRACTORS TO U. S. ARMY AIR CORPS

AVIATION April 1942

AVIATION April 1942

107

**TOUGHENING "CYCLONES"**

**SC FURNACES ARE PLAYING THEIR PART IN HARDENING AND DRAWING WRIGHT "CYCLONE" AIRCRAFT ENGINES**

Eighty-four different parts for the Ingersoll Wright Cyclone Engine are hardened in this Surface Combustion Endless Tube-Continuous Furnace. These parts vary in weight from 47 pounds to 1/2 ounce and up from crankshafts, master rods and cam shafts all the way down to 1/2" shaft screws and nuts.

The parts are loaded on trays and charged into the furnace through a side door and are then moved through the furnace by a pusher mechanism. Larger parts are held suspended in a crane while smaller parts are quenched automatically. After quenching the parts are drawn in a Surface Combustion batch type annealing furnace.

The experience of Surface Combustion engineers is available for helping with your heat treating problems.

**SURFACE SC COMBUSTION**

TELEPHONE 2-1000

NEW YORK, N. Y. 10001

CHICAGO, ILL. 60606

PHILADELPHIA, PA. 19104

PITTSBURGH, PA. 15203

ST. LOUIS, MO. 63103

WASHINGTON, D. C. 20001









*"Working for Victory"*



*Uniform*

## PACKARD AIRCRAFT CABLE

Every step in the manufacture of Packard aircraft cable is carefully controlled, to maintain absolute uniformity. Packard cable is always dependable.

**Packard**  
PACIFIC DIVISION  
PACKARD ELECTRIC DIVISION  
General Motors Corporation, Warren, Ohio

points in the saw woods, such as spruce and bass, gave no particular advantage to the resin, since the resin points gave just as high percentage of wood failure with comparable shear strengths. (See Figs. 2 and 3.) The superior mechanical strength of the resin was shown in the shear tests of the hardwoods, typified by birch and maple, where the average shear value was 2,778 lb. per sq. in. for the resin as compared to 1,732 lb. per sq. in. for castor glue. The specimens were all birch and the lowest percentage of wood failure was 53 for the resin as compared to 55 for castor.

In addition to cold water immersion, a boiling test was arranged consisting of a cycle of eight hours in boiling water, eight hours in cold water and eight hours drying. The cycle was continued for 200 hours, after which the specimens were usually destroyed. No evidence of pine failure could be found.

Another four foot panel of typical wing construction was submerged in a tank of boiling water for a day after which it was oven baked to develop violent shrinkage stresses. Subsequent examination showed that the resin bond successfully resisted the stresses, while similar panels with other adhesives completely disintegrated in the boiling water after only a few hours' immersion.

The test panel shown in the photograph has been out longer than its surroundings on the wall after over a year of exposure, while duplicate panels with other adhesives have long since collapsed.

With the rapid growth of both the plastics and the airplane industries, it is difficult to forecast their most direct relationship, but we may safely predict that the synthetic resin will increasingly continue to infiltrate the airplane structures and that their use will be associated with trend to a more advanced and lasting type in the new production structural materials, and to a reinforcement, binder and sealant in the welded joints.

### References

1. N. E. Clark, *Leak Resistant Structures*, McGraw-Hill, New York, N.Y., 1937.
2. D. W. Brown, *Plastics for Aircraft*, McGraw-Hill, New York, N.Y., 1937.
3. *General Motors Products Catalog*, Warren, Michigan.

### Barrage Balloons

(Continued from page 127)

last year, the number of balloon barrage balloons has grown to colossal proportions and few important areas are now left without balloons. The density of spacing has also been increased almost to the optimum.

The purpose of the barrage is not



## He's stretching the range of a bomber

Every ounce of weight saved in the design and construction of our big, high-flying bombers means they can carry payloads much more fast, lengthening their bombing range.

Every ounce of weight saved makes our war birds go much faster, pack more punch on bombs and use power, loading new respect for them and us in Tokyo, Berlin, Rome.

One of the principal reasons Hycar is so widely used in aircraft is the real weight-saving factor. The ordinary bar (round) bar parts made of this old American synthetic rubber, shown above in coiled form, can produce a saving of 37% to 37% over most other synthetics. And with Hycar now being used more liberally millions of individual aircraft parts in thousands of separate units and designs the significance of this saving becomes apparent.

But Hycar is contributing more than its light weight to America's might in the air. Extreme resistance to gasoline and oil, its abrasion in the presence of oil, and the ability to be molded in precise dimensions—these are Hycar properties of major value in aircraft construction. Ask your rubber products suppliers for samples made with Hycar. And remind them that our reinforced wall is ready now to work with them in the solution of your problems.



Left: Hycar, right: rubber



Typical pressure welded parts



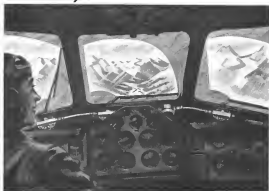
Reinforcing bar



Reinforcing bar and mesh

**HYCAR** CHEMICAL COMPANY  
Akron, Ohio

# Sight... WHERE SIGHT IS VITAL



## Acrotorque Wipers Assure Visibility, Through Rain, Sleet and Snow

From a single motor unit, the ACROTORQUE All-Weather Windshield Wiper effectively clears ice, rain, sleet or snow windshield sections of flat or curved glass. ACROTORQUE is the wiper now flying with the U.S. Army and Navy . . . proved in actual flying hours by U.S. Transport Lines from coast to coast.

### THE ACROTORQUE COMPANY

4815 LEXINGTON AVENUE, CLEVELAND, OHIO  
5658 WILSHIRE BLVD., LOS ANGELES, CAL.

# ACROTORQUE

THE WINDSHIELD WIPERS  
FOR AMERICA'S AIRCRAFT

usually to bring enemy aircraft down, but rather to force them to fly above 5,000 ft. where anti-aircraft or fighter defenses can deal with them. In particular, the deadly development of land algorithms is making impossible, and only the relatively inaccurate high-altitude bombing can be used.

Pair of living rate cables has also caused the enemy to take drastic precautions with its aircraft, which are sometimes fitted with devices such as the bomber force, designed to protect them but which add weight and decrease bomb load and speed.

#### CONVOY BALLOON BARBAGES

The most recent application of balloon defense has been the installation of this apparatus on merchant ships in convoys and it has been most beneficial in reducing the number and efficiency of dive bombing attacks on ships.

Shoppers now have so much confidence in the protection thus afforded them, that they are reluctant to sail without their "insurance," and many cases have been recorded where battles have approached a convoy for an attack, but were given it up as it had jettisoned the balloons go up. Before these were used, large ships were lost, but these were proved, silence. The naval type balloon is much smaller than the land type, having capacity of only 2,500 cu. ft. and measuring, instead of the balloon stabilizing line which are usually seen, less than "shut's" fit" stabilizers stayed by bracing wires.

#### 'BALLOON' LOSES WEIGHT

Neither with the panel nor land-based type of balloon is there much wasteage by direct attack, from enemy aircraft. It is far too risky for the planes concerned. By attacking the balloons they automatically give their attack to the anti-aircraft batteries which are only too glad to get the opportunity of an accurately-targeted target. Moreover, as one balloon goes down, another immediately succeeds in its place, and maintenance and production is so well in hand that it can easily keep pace with losses through all causes. Grounded losses are incurred by damage from shell fragments of our own gunfire and, of course, lightning sometimes strikes balloons. High winds occasionally tear them from their moorings and they then drift across country and sea, or end their journey on a mountain side.

However, from all causes, balloon wastage is comparatively light. There is a complete turnover of new gas bags every few months. Continuous maintenance it, of course, carried out on the sea, and the fabric is periodically examined for tears and holes which affect buoyancy, and these are repaired.

The barrage personnel who originally

## DARNELL CASTERS & WHEELS

### KEEP THEM ROLLING



## Darnell Casters, Wheels Speed Up Production in the AVIATION Industry

Every type of caster and wheel used in the Aviation Industry fully described in this 192-page Darnell Manual. Write today.

DARNELL CORP. LTD., 4004 BEACH, CALIF.  
31 N. CLINTON, CHICAGO • 50 WALSH ST., NEW YORK

# WORLD LEADERSHIP



## Wilco Electrical Contacts and Thermostatic Bi-Metals

• Just as Wilco research produced Electrical Contacts and Thermostatic Bi-Metals which were chosen on the basis of their matchless performance and absolute dependability for use in practically every piece-of-line industrial device—so now these highly developed materials are being used for war purposes.

• Wilco Electrical Contacts are performing with outstanding success in aircraft, tank, gun and ship applications.

• Wilco Thermostats (thermostatic bi-metals) are being used with equal success in various instruments for the Army and Navy.

• Fast growing, too, are the uses for Wilco Powder Metal Contacts in higher frequency applications above 20 mcps.

Take advantage of more than 27 years Wilco experience. Without obligation send us your problems for analysis or write for a copy of the Wilco Blue Book of Thermostats and Electrical Contacts.

**The H. A. WILSON CO.**

185 Chestnut St., Newark, N. J.

Branches: Chicago • Detroit



AVIATION, April, 1942

## Worthington AIRFIELD "Grass Blitzer"

*Solves your problem of  
developing and maintaining  
proper turf — faster, more  
efficiently*

Frequent, regular cutting is necessary to develop thick, dense turf. Thick, dense turf accomplishes the following necessary objectives:

1. Keeps down dust which is a cause of too frequent motor tear-downs and parts replacements.
2. Helps eliminate hazards of loose stone, aggregate gravel, etc., injuring propellers during motor run-ups, take-offs and landings.
3. Absorbs rainfall, preventing muddy areas and the danger of screen skids.
4. Helps eliminate wheel marks which can be photographed from as high as 50,000 feet.

At 20 m.p.h. the Worthington Airfield "Grass Blitzer" cuts 60 acres per hour or 368 acres per 8-hour day — the largest capacity mowing machine ever developed. This high cutting speed enables the "Grass Blitzer" to keep out of the way of plane traffic. (A short-wave radio receiver is available to enable the field control officer to direct its movements and eliminate the danger of collision.)

Maintenance of Airport Fields is simplified by the "Grass Blitzer" Transport Trailer which enables the tractor element to haul the cutting unit for immediate use when and where needed at highway speeds in excess of 30 m.p.h., eliminating the necessity of moving equipment for each individual Airfield surrounding a Main Base.

Before purchasing old-style equipment it will pay you to investigate thoroughly the new Worthington Airfield "Grass Blitzer."

Fill out and mail this coupon, today, for brochure, illustrated outline—"The Worthington Airfield 'Grass Blitzer'—A Study of Airfield Self-Turf Area Grass Cutting and Maintenance Problems."

**WORTHINGTON MOWER COMPANY**

MAIN OFFICE, SPRINGFIELD, PA. • SALES BRANCHES ALL PRINCIPAL CITIES

AVIATION, April, 1942



WORTHINGTON MOWER COMPANY  
BPT. A. A. • SPRINGFIELD, PA.

Please send cutting ability details and specifications of the Worthington Airfield "Grass Blitzer"

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_



# Again MICRO SWITCH

makes a contribution to the aircraft industry!

## THROTTLE WARNING SWITCH BRACKET



Inset of right shows the spring mechanism of the Micro Switch

The new Micro Switch throttle warning switch bracket enables Air Corps Approved Type II Micro Switch offers a light weight, easily assembled device for closing the warning circuit when the bracket is considered part of the aircraft, no clearance permit is required.

Installation of the throttle warning switch may be accomplished by one person. This reduces the Air Corps approved Micro Switch through the spring mounted plunger B, thus closing the warning circuit.

If the circuit is to be opened with the throttle still installed, the reset nut C is immediately pushed, causing the dis-

placement plunger B to disengage the closed limit, and permits the Micro Switch to return to its open circuit condition. Upon next movement of the throttle, the spring carrying B causes it to its normal position ready to again operate the Micro Switch on next throttle movement.

Only a small amount of force is required to operate the switch, and as a result, small remote motion of the lever's reset plunger B for the next cycle. Lever A may be over-extended to more than 10° beyond the point of switch operation.

The standard single assembly may be conveniently gauged in two, three or four unit assemblies with operating levers on any desired center. No close alignment is required. Reset of any switch or switches

may have been operated in succession by the one push control. When deeper manual operation is not convenient, remote cable control can be used.

A sample of this bracket and Air Corps approved switch will be sent on request. Examination will demonstrate its light weight, simplicity, and dependability in a wide range of mounting methods. This same device has been found useful for operations other than throttle warning control, and Micro Switch engineers are ready to cooperate on such applications.

New catalog No. 70 contains complete information describing characteristics, prices, and uses of Micro Switches for aircraft and aircraft accessories. Write for your copy.



4-107500-0001

# MICRO SWITCH

Manufactured at FREEPORT, Illinois, by Allen-Bradley Corporation, Sales Office New York, Chicago, Boston

## Maintenance Men

(Continued from page 151)

who have been restricted in their flying activity, have taken advantage of this opportunity to get their planes evenhanded at low cost without concern for the future elements involved. The school is likewise able to compare ground school with actual operational experience which increases their value for the important jobs they will be called upon to do in the nation's vital commercial operational centers.

The corresponding photographs and captions describe, in detail, the methods and facilities used in providing maintenance and service men for the Army and commercial flying services.

## Airline Air

(Continued from page 161)

Two position deeper motor

Relay to close deeper on last stop down

Two position steam valves for the tempering coil

Modulating steam valve on the main heating coil

Electrical set at 35 deg. F. controlling the steam valve supplying the tempering coil

Reversing valve permits which is closed water to flow down for an amount of low steam pressure

High pressure cut-out on the Freon compressor

Reversed operated water valve on the water line to the condenser

Heating plant consisting of the following:

A 3 1/2 inch boiler operating at 75 to 100 lb. gauge pressure and capable of 300,000 Btu per hr. output. This boiler uses fuel oil and is complete with burner, feed pump, blower, and necessary equipment to make it full automatic in operation.

A steam main supplying steam to heating coils in conditioning cabinets.

Coordinate entire traps and vents for return of condensate to receiver.

A vented receiver to collect non-condensate and supply the boiler feed pump by gravity. This tank is equipped with a float control valve for make up water as required.



See this above on the only in space inside 1 1/2" I.D. with 1/4" weight in wall and also see the mounting flange at right.

## Speed Up Assembly with REX-FLEX

### STAINLESS STEEL FLEXIBLE TUBING

*Res-Flex Can Be Readily "Snaked" Into Place In Cramped Installations Such As Elbows and Sharp Bends, Eliminating Joints.*

Accessories manufacture supply many installation problems involving air ducts, heat tubes, radio shielding conduit, power plant accessory parts, oil and gas flexible lines by using Res-Flex Stainless Steel Flexible Tubing. Extremely light in weight, bendable in multiple planes, obtainable in long lengths.



See above on typical Res-Flex Assembly.

#### High Torque Valve—

#### Heat and Corrosion Resistant

Res-Flex Stainless Steel Flexible Tubing is available in five wall thicknesses, all of which can be combined in a single one-piece length, with straight walls and corrugated sections. Standard intervals range 3/16" I.D. to 5" I.D. (incl. Made of 18-8 (Austenitic) Stainless Steel. Flanges are attached to tube ends by conical resistance welding.

No Flex, No Hoses, No Quenching—Proving Absolutely Tight, Homogeneous Assemblies

—Data and Engineering Recommendations at Request—

**CHICAGO METAL HOSE CORPORATION**  
NATWOOD, ILLINOIS



## PENCO Steel Shelving

### \* first aid for VICTORY PRODUCTION



- \* Saves Floor Space
- \* Saves Time and Material
- \* Simplifies Stockkeeping
- \* Splinter- and Fire-proof



#### FREE CATALOG!

Contains useful information concerning types, sizes and prices of PENCO Steel Shelving. Illustrates construction and assembly details with dimensions and load carrying capacities. Write for your copy today or write for details.



STEEL SHEDS AND SHEDS  
STORAGE GARAGES  
TODAY STABLE & CHEAPER

**Penn Metal Corporation  
of Penna.**

Is Located Conveniently Near You  
25 Oregon Avenue, Philadelphia, Pa.

## Good Neighbors

(Continued from page 55)

been urged to share by the European nations. Natural sources of supply for many vital goods were closed, and ordinary outlets for such quantities of coffee, wheat, hides, wool, rubber, tin and many other products were closed by the blockade and shipping shortages.

#### AVAILABLE RAW MATERIALS

The loss of the supply sources in the Far East will make it imperative that the South American sources be tapped with all possible speed. Rubber and tin which we had formerly obtained from Indo-China and the Dutch East Indies, are available from the forests and mines of Brazil, Bolivia, Peru and Central America. Phosphorus and platinum, formerly imported chiefly from Africa, are available in Brazil and Colombia. Copper, bauxite, chromium, nickel and tungsten ore will be supplied from South American countries. We already have a large trade in such products as coffee, gum, nuts, tobacco, fertilizer, oil seeds, bananas, hardwood, lumber, fresh and dried fish and many fruits and cereals. During the war and after the war, the trade can be successfully expanded. When the war is finished and we get back to the business of producing goods and consumer goods, we are glad to see South America really stretch for such American products as crude oil and fuel oil, gasoline, zinc oxide, machinings of all kinds, solvents, fasteners, building materials, electrical equipment and appliances of all kinds, industrial chemicals and many other items.

In all of this it is imperative for us to remember that there are 20 different countries in the Latin American trade area. These people must be understood by us if we are to do business with them. They are chiefly divided by

differences of race, language, climate, geography, and temperament. We must build our future commerce by following old methods, or by sending the salesmen down to negotiate our trade arrangements. This is a job for the boss and a job for men in the field. And that means that he—more thousands of him—will have to pile into an airplane and go down for a personal study of the particular situation which interests him. As our entire hemisphere makes up a new problem will likewise increase and bring with it an inevitable tightening of the bonds between North and South America. We must bear in mind that most South American people are linked closely to Europe by ties of blood, culture and commerce. Our chief hope of developing that promise to our mutual benefit is to make the best use of the airplane.

For example, we have arranged to produce a catalog in both the Spanish and Portuguese languages, listing the products of the Los Angeles area with directions as to how they may be obtained. This catalog is being sent to a select list of Latin American business men by air mail, and many of the products listed in the catalog will be shipped by air express.

#### VITAL ROLE OF AIR TRANSPORT

It can be seen then that the airplane is making it possible to establish the necessary contacts rapidly, and it is through this means that a firm foundation is being laid for future expanded trade. Air express is expediting the exchange of samples, commercial papers, and bills of lading and the air mail is providing the means for the rapid interchange of vital information and business agreements.

It seems definitely within the realm of possibility, too, that many areas of critically needed raw materials will be transported by air from South American reservoirs to supply to the United States. South America has been the proving ground for air freight, and such opera-

# EXACT CONTROL IS Vital..



**GLOBE  
STEEL  
TUBES**

— to maintain consistently uniform quality in the manufacture of Globe Steel Tubes. A large and fully equipped chemical and physical laboratory, manned by graduate metallurgists, is back to the exact control of production maintained at Globe Steel Tubes Co.

is utilized in the most advanced machinery and methods in the mill, under the direction of a large staff of experienced engineers and technicians, the Globe Steel Tubes Co. laboratory is another important factor which contributes substantially to the inherent quality of Globe Steel Tubes... quality which has won them high recognition with utilities, leading railroad, industrial and marine boiler builders.

**GLOBE STEEL TUBES CO.  
MILWAUKEE, WISCONSIN**

## GLOBE STEEL TUBES

STEAMLESS TUBES • ROLLER TUBES •  
CONDENSER AND HEAT EXCHANGER  
TUBES • MECHANICAL TUBING...

## SIMMONDS-BENTON AIRCRAFT POWER PLUG

### Another "Solo"



Simmonds-Benton Power Plug—the only plug in the world with a Triple Taper Seal. Note the tapered sealing device, tapered spiral winding, and tapered backing — for dependable performance under the toughest conditions. Interchangeable replaceable part construction is another Simmonds-Benton feature, making thorough inspection easier and quicker, lengthening useful life.

DISTRIBUTORS: We have a prospectus that will inform well-established dealers. Write for the facts.

**SIMMONDS AEROCOSSORIES, INC.**

10 ROCKEFELLER PLAZA, NEW YORK, N. Y.

## Gathering, editing and distributing INFORMATION for users of alloys



1. Field offices of the  
Development and Research Division  
2. Distributors' Coding Service Centers

To aid users of Nickel alloys, thirty service centers are maintained in industrial areas. From these strategically located key points, our field representatives are on call to advise American industry about the selection, fabrication and use of ferrous and nonferrous materials. Assistance is also given in problems arising

from the temporary lack of Nickel.

Through the years, research, field studies and user experience have all contributed to a fund of practical, time-proven information. Many of these data have been compiled in convenient printed form, useful both to experienced men handling new materials or performing un-

familiar operations...and to the many new engineers.

Now...when minutes and materials are so vital...make full use of this metalworking experience. Send for a check list of helpful printed pieces on the selection, treatment, fabrication and use of Nickel alloys, or send your specific questions to:

**THE INTERNATIONAL NICKEL COMPANY, INC.** 87 WALL STREET  
NEW YORK, N. Y.

tion have been conducted on a rapid and accurate scale for many years. To date, most of the cargo has consisted of finished products and knowledge, but with time of the moment it seems certain that great shipments of raw materials will be required in the war. As a result, an entirely new concept of trade relations with our neighbors will be established.

American is giving us the means by which to make the most of our golden opportunity to become mutual customers and business associates. Once we have established trade relations, we should be able to rely upon the American production of the means used to build a foundation of good will for Western Hemisphere business, industrial, and social relations that will set an example for a world determined to achieve a democratic peace.

### Book Review

(Continued on page 114)

If one ever had any difficulty in remembering to mention the various cloud formations and their names, it will find in this book a simplified glossary, now presented by a splendid collection of cloud paintings. Mr. Stange has done with his brush what St. Francis did in writing to bring to the vulgar a sensitive and appreciative glimpse of the sky's charm.

After closely examining the origin and characteristics of the various cloud formations, the author describes by means of well chosen text and pictures, the origin of "weather" in general, and its presentation in the form of weather maps for the guidance of pilots. Scattered throughout the picture-story will find many pertinent tips on how to conduct himself in flight through various weather conditions.

**WINDS OF DEFENSE**, by Captain R. W. Lyman. Published by E. P. Dutton & Co., Inc.; New York. Illustrated, 210 pages, \$2.50.

For the layman just wondering to the origin of our place in world affairs, this book gives an excellent sketch of the types of planes employed by both land and sea forces, together with an outline of the facilities needed to provide the planes and the men to fly and maintain them. In almost every case, today's ships and their facilities are so planned against a background of the lessons learned in World War I, when Captain Lyman was fighting as a pilot.

Of particular value is the explanation of the tremendous problems attending expansion of production.

In addition to the chapters on fighters, bombers and naval aircraft and their functions, the book also treats the development and painting and bombing. The enormous educational requirements for Army and Navy pilots are detailed in the chapter on pilot training, which describes the development of both equipment and the kinds of flying necessary in modern warfare.

**WOMEN WITH WINGS**, by Charles E. Plaut. Published by Harper & Brothers, New York. 312 pages, \$2.75.

"Seven months after the first man flew, the first woman flew. In 1904 Yvonne de la Motte was the first of her sex to fly. That's the way Mr. Plaut's book starts, and it stays just as good all the way through such chapters as 'The Hands That Shaped the Controls', 'Women Teach', 'Mr. and Mrs. W. With Plane and Motor Through the Public Press'. It seems, and is, positively amazing, because the author is an irresponsible light heart, but actually the book is loaded to the brim with solid information.



**precision** **quick**

In close-precision work, accuracy is essential. Inaccuracy is caused by loose tolerances. From that very accuracy, however, comes the precision of the work. Precision is the result of the work. Precision is the result of the work. Precision is the result of the work.

### FOR AIRCRAFT HYDRAULIC SYSTEMS The Simmonds-Oiler ACCUMULATOR

Based on a proven design that has been years of service in European Armies, the Simmonds-Oiler is the only accumulator in the world that is built by Simmonds for use in aircraft. It is built to last, is simple in design, and is built to last. It is built to last, is simple in design, and is built to last.



In case of pump failure, the pressure generated by the accumulator is used up to operate many hydraulic devices on the plane. It is built to last, is simple in design, and is built to last.

**SIMMONDS AEROCOSSORIES, INC.**  
11 ROCKEFELLER PLAZA, NEW YORK, N. Y.



**LAMINUM**  
THE ONLY ONE THAT'S PROVED  
THE ONLY ONE THAT'S PROVED

highly more than \$100,000 annually. The recent looks rather promising when compared to the earnings of most of the single industrial company of national importance. Further, only a few air carriers have thus far demonstrated any real economic problems—American, Eastern and Northwest.

The proposed tax measure together with developing new developments were primarily responsible for most of the air transport securities breaking to new lows for almost three years and in some instances probably close to the bottom levels established during 1938 and 1939. The general market of common stocks was down to earth.

Eastern Air Lines, for example, during 1940 and early 1942 while "boom" as it were, repeatedly reduced its payments \$24 per share on the common. While a certain amount of weakness was indicated by the company's report surrounding reduced net compensation, it was the tax and new laws which first caused the support to waver, the stock, however, buoyed through its old resistance level.

Similarly, American Airlines, in the face of an excellent earnings report, broke through its previously established resistance level of \$40 per share. The speed stock advanced to \$67.50 shares and the subsequent CAB decision further propelled the stock to a new low.

#### NORTHWEST STOCK STRONG

The strongest airline security, however, has been Northwest Airlines, Inc. While listed on the New York Stock Exchange for only slightly more than a year, the stock has given an excellent account of itself. At one time United Air Lines, TWA, and Pan-Continental all sold at higher levels than Northwest. Today that is no longer true. This financial action may be attributed to a genuine earnings record on the part of the company. There is also considerable "insurance" attached to Northwest in terms of possible new routes. The company's application for a route to Alaska has created a bit of considerable excitement in view of that area's importance. Northwest also has fiscal year benefits, its security bonds being closed on June 30. This should show the effect of tax laws imposed by a half year.

While most of the major airlines (American, Eastern, United, TWA and Pan-Continental) report on a calendar year basis, the bulk of the industry's earnings drive their profits accounts on a fiscal basis, usually at June 30.

Returning to the American Airlines offering provides an interesting sidelight. It may be noted that this trans-

action represented an issue financing for American. This stock came from the Aviation Corp. which received a total of 100,000 shares upon converting American Airlines debentures at July 6, 1940. At that time there was some question as to the legality of Aviation Corp. being permitted to hold the stock without approval of the CAB. Under Section 408 of the Civil Aeronautics Act of 1938 it is intended unless so approved for any person engaged in any other phase of transportation to acquire control of any air carrier in any manner whatsoever. In Aviation Corp. has long been identified with aircraft manufacturing properties (Volvo, for one), a conflict with its stated purpose possible.

This provision of the 1938 act contained a principle of the Air Mail Act of 1934 separating any interests relating between an air and contractor and an aircraft manufacturing company. It was this provision which on early 1939, finally led North American Airlines to dispose of Eastern Air Lines. American Corp. relied on authority by American's Air National stock with Jesse Jones, an trustee. Provision was made for the termination of the trust any day during its specified life, in the sale of the trust certificates by Aviation Corp. in which event the new holders could surrender their trust certificates and receive the actual stock from the trust. At the time of this agreement there was good reason to believe that American Corp. was strongly determined to dispose of its American Airlines stock.

Now, about eight months later, in a surprise move, Aviation Corp. decided to sell half of its American Airlines holdings. The more honest its present situation in the wake to about 35 percent of the outstanding common stock. This will leave Aviation Corp. as the largest single stockholder in American Airlines and would be considered in the eyes of the CAB as the controlling factor. Under such circumstances, it would not be very surprising if the remaining 100,000 shares of American now held by Aviation Corp. were to be sold in the near future.

#### SHIFT TO MANUFACTURING

Why did aviation leaders depart from the air transport industry for Aviation Corp.? The answer may not only clearly be possible before conflict with the CAB, but may represent another phase in the broadening of interest in aircraft manufacturing by American Corp. During the year, Aviation Corp. owned Volvo Aircraft, which it controlled through a 71 percent stock ownership, an active control of Consolidated Aeronautics Company. Consolidated is proposed to merge both aircraft prop-

erties under one corporate structure.

This combined shift to manufacturing by Aviation Corp. is similar to the pattern pursued by U. S. and Motor Corp. many years ago.

There are two phases to aviation—manufacturing and transport. Experience indicates that in the long run the manufacturing end of any transportation industry is the more profitable—or at least easier to manage. This line of reasoning is clearly evident when the interests of General Motors' 100 years of endeavor in aviation are considered. About September 19 the machine entered in General Motors in TWA along with complete ownership, through North American Airlines of the company was known as Eastern Air Lines.

General Motors sold its TWA in 1935 and ever having to manufacturing in preference to air transportation activities caused the properties surrounding Eastern Air Line to be sold in 1938. GM's sales not only avoided possible conflict with the Air Mail Act of 1934 but also permitted General Motors to concentrate on the aircraft business as preferred and where it considered the best place to be—its manufacturing.

Similarly, the properties in the Aviation Corp. orbit may now be shifting to a manufacturing or, that coming, manufacturing may be devoted to manufacturing and where all possible circumstances can be required.

Consolidated, American Corp., in retrospect, did not employ the most favorable timing in the disposal of its American Airlines stock. During 1940, this stock sold at high as \$75 per share. While Aviation Corp. owned American Airlines debentures at that time, such securities were convertible into common stock at that period and could have been sold in that manner if so desired. In any event, Aviation Corp. realized a profit of about \$2,400,000 on this transaction which will be subject to a normal income tax of at least 38 percent. Moreover, if it is intended to sell the remaining 100,000 shares of its 100,000 common shares, it will be avoided.

Aviation Corp. also owns 983,477 shares or about 38 percent of the outstanding common stock in Pan American along with investments in New York Shipbuilding and Vulcan Control.

It is in Volvo, however, that Aviation Corp. has shifted its design. As part of the Consolidated deal, Aviation Corp. purchased an additional 100,000 shares of Volvo common stock, bringing its interest in that company to 90,185 shares or about 33 percent of the outstanding common stock. When Volvo and Consolidated are ultimately merged, Aviation Corp. may be in control at what may turn out to be the largest aircraft manufacturing enterprise under one corporate structure.

## IN WAR AS IN PEACE EDO STANDARD FLOATS MEET EVERY TEST



For 17 years the Edo organization has applied itself to the building of all-metal seaplane floats. Early it was recognized that the production of float gear to the highest engineering standards would claim the full energies and technical skill of an entire organization—research, engineering, manufacturing and flight testing.

Holding to its special field, Edo has kept pace,

step by step, with aviation's far-reaching advances. Today Edo floats are not only the most numerous in service but are recognized as "standard the world over"—manufactured for efficiency in the air and on the water.

No greater proof of the inherent soundness of Edo design and construction could be asked than the simple fact that standard "Vomamerial" Edo

Twin Float installations—without modification—are now rapidly seeing on naval and military aircraft of the United States and allied nations.

If you are a civilian pilot—in CPTP training, as CAP ship, or serving in other ways—you may equip your plane with standard Edo floats with the knowledge that better floats are not made. For details, write Edo Aircraft Corporation, 4902 Second St., College Point, L. I., N. Y.

### EDO STANDARD TWIN FLOAT GEAR

Examples of standard models in use on both Civil and Military airplanes



# EDO Floats

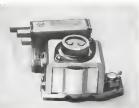
STANDARD THE WORLD OVER



**G-E Switch** Weighs 9 grams; measures  $1\frac{1}{2}$  in. x  $1\frac{1}{2}$  in. x  $1\frac{1}{2}$  in. Comes in series single throw or two-position form, and provides one normally open or one normally closed contact, or both one normally open and one normally closed contact, has double break contact construction. See Bulletin GEA-381 for further information.



**Sensitive D-C Relay** Weighs  $3\frac{1}{2}$  grams; has a maximum coil current rating of 5 amperes at 24 volts d.c., and a maximum make or break rating of 10 amperes; provides single pole, double-throw contact arrangement. Sealed design; gives protection when star and coil over damage from rough handling. Detailed description in Bulletin GEA-3919.



**Aircraft Solenoid** (Type G-9) Weighs 5.7 pounds; operates on 4.5 amperes at 24 volts d.c., or 58 C. contact temperature. Built to meet U. S. Government specifications. Complete details given in Bulletin GEA-3829.



**Limit Switch** Weighs 2.15 ounces; install with screw in the G-E switchlets, has  $\lambda/32$  in. (optional), measures approximately  $5\frac{1}{2}$  in. x 3 in. x  $1\frac{1}{2}$  in. For full information about this sturdy electronic-limited limit switch, see Bulletin GEA-3831.

# General Electric

*now offers*

# Aircraft Controls



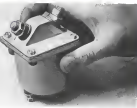
**Single-Pole Relay** Weighs 6.1 grams; has a maximum coil-current rating of 25 amperes at 12 or 24 volts d.c., and a maximum make or break rating of 100 amperes; provides one single-pole normally open double-break contact. Detailed description in Bulletin GEA-3913.

## G-E Aircraft Controls Meet These U. S. Govt. Requirements

1. Navy 200-hour life-span test
2. U.S. Govt. vibration stipulations
3. Operates at rated current up to 40,000 feet altitude
4. Withstand linear acceleration of 10 G applied in any direction
5. Operates at temperatures from  $-40^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$  or  $95^{\circ}\text{C}$



**Single-Pole Relay** Weighs 3.1 grams; has a maximum coil-current rating of 50 amperes at 24 or 24 volts d.c., provides one normally open, or one normally closed and one normally closed contact. Two-pole and three-pole forms of this relay are also available. Bulletin GEA-3812 gives complete details.



**Synchrostat Connector** Weighs 2.3 pounds; operates on 15 or 24 volts d.c., handles an arcing of 100 amperes at 28 volts; provides one single pole normally open contact; has a 30-ampere rating based on the NEMA 8-hour test. Bulletin GEA-3815 gives full information.

General Electric announces a line of control devices for aircraft electric systems. Most of the devices shown here are already in production; others will be shortly. Our Research Laboratory, our designers, and our manufacturing organization are pledged to meet the rigid standards of today's fighting ships.

**If You Don't See  
What You Want...**

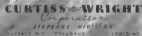
*ask for it*

A new and fast-moving industry calls for the development of many new electric products. We invite you to bring your special control problems to our Industrial Control Division. Its engineers will gladly discuss with you the design of new electric control devices to meet your needs.

**For bulletins listed under pictures,** or for information about the design of new products, write Section 676-73, General Electric Company, Schenectady, N. Y.



**GENERAL ELECTRIC**



# In **ONE** way all these American war planes are alike

★ All American fighting planes have one important feature in common. Their engines are designed for high-octane gasoline. That's the basic reason why they have more power than similar enemy planes. And because they have more power, they will—place for place—outfly and outfight our enemies!

We alone have all three things needed to produce high-octane gasoline—and plenty of it are—vast reserves of high quality crude oil, low-expensive refining processes, developed by American's petroleum

industry, three—adequate production of anti-knock fluid to improve octane ratings of ordinary gasoline.

The makers of Ethyl brand of anti-knock fluid have granted their plants, laboratories and technical staffs to meet the oil industry's war needs. That's why in war, our Army, Navy and Allies have first call on Ethyl fluid to make fighting fuels for planes, tanks, armored cars and other mechanized equipment.



AMERICAN'S  
VAST RESOURCES OF HIGH  
QUALITY CRUDE OIL



SUPERIOR REFINING  
PROCESS DEVELOPED BY  
OUR PETROLEUM INDUSTRY



ADEQUATE PRODUCTION  
OF ANTI-KNOCK FLUID  
(continuously increasing output)



SUPERIOR  
AIRPLANE  
FUELS



ETHYL BRAND OF ANTI-KNOCK FUEL

WHICH ETHYL GASOLINE CORPORATION

**CHECK** these advantages of the Torrington Needle Bearing—advantages that have been tested and proved on thousands of applications—and we have every feature can be utilized to fill a wartime need in your product designs.

1. **The Needle Bearing is available for prompt delivery on present orders, in the standard sizes and designs that are most procurable today.** Production capacity at Torrington has been expanded to care for all essential requirements with the promptness you need to maintain your manufacturing schedule.

2. **It is easy to install, ideally suited for high-speed production line methods.** Built on a single compact unit, the Torrington Needle Bearing is ground into place in the housing in a quick, simple operation.

3. **It overcomes material in other parts of your product design.** Because the bearing's outside diameter is small in proportion to capacity, you can use small-diameter housing, requiring less material.

4. **It improves product performance and reduces power requirements, because of its low coefficient of starting and running friction.**

5. **It needs little attention in service.** As a result of its efficient system of lubrication, only occasional renewal of lubrication is necessary. Its high load capacity assures long bearing life, even in continuous operation under heavy loads.

Let a Torrington engineer show you how this essential bearing can help you keep your design to wartime conditions. For details, wire, phone or write for Catalog No. 116.

THE TORRINGTON COMPANY

1400 and 1410th Street, S.E., Portland, Ore.

Branches of Torrington Needle Bearings

New York	Boston	Philadelphia	Chicago
San Francisco	Los Angeles	London	Frankfurt

EVERY FEATURE  
FILLS A WARTIME NEED



## TORRINGTON NEEDLE BEARING

### INCREASED EFFICIENCY



Torrington Needle Bearings reduce power consumption in the "Link-forgers" line of steel metal working equipment—and with thousands of machines in daily use over a five-year period, bearing replacement has been negligible. Continuation of the bearing in use and better lubrication.

THE TORRINGTON COMPANY

### ELIMINATION OF WEAR

The Needle Bearing's low coefficient of friction usually eliminates wear on the control rollers of the CRONA T-16. Replacement rollers are kept to a minimum of possible wear. Needle Bearings are used, which include landing gear, roller bearings, and wing tip bearings.



CRONA AIRCRAFT COMPANY

### LIGHTNESS IN WEIGHT



Light weight and small size is important to power rating on maneuvering features of an aircraft or portable engine. Compact, high capacity needle bearings are used in increasing these demands. Features that are very weight sensitive. Installed by the General Aircraft Company.

INTERROLL-BEAR

# SPEED VICTORY!

## 50 SUBJECTS

16 MM SOUND-ON-FILM

THESE 33 IMMEDIATELY AVAILABLE

### 5 ON THE ENGINE LAKE

1. Rough Turning Surfaces Features
2. Landing While at 0 Manoeuvres
3. Landing a Light While the Landing Gear is at 0 Manoeuvres
4. Landing a Light While the Landing Gear is at 0 Manoeuvres
5. Landing a Light While the Landing Gear is at 0 Manoeuvres

### 5 ON THE MACHINE WORKING

1. The Machine Working
2. Landing While at 0 Manoeuvres
3. Landing a Light While the Landing Gear is at 0 Manoeuvres
4. Landing a Light While the Landing Gear is at 0 Manoeuvres
5. Landing a Light While the Landing Gear is at 0 Manoeuvres

### 5 ON THE VERTICAL BORING AND

1. Rough Turning Surfaces Features
2. Landing While at 0 Manoeuvres
3. Landing a Light While the Landing Gear is at 0 Manoeuvres
4. Landing a Light While the Landing Gear is at 0 Manoeuvres
5. Landing a Light While the Landing Gear is at 0 Manoeuvres

### 5 ON THE MACHINE WORKING

1. The Machine Working
2. Landing While at 0 Manoeuvres
3. Landing a Light While the Landing Gear is at 0 Manoeuvres
4. Landing a Light While the Landing Gear is at 0 Manoeuvres
5. Landing a Light While the Landing Gear is at 0 Manoeuvres

### 5 ON THE ENGINE LAKE

1. Rough Turning Surfaces Features
2. Landing While at 0 Manoeuvres
3. Landing a Light While the Landing Gear is at 0 Manoeuvres
4. Landing a Light While the Landing Gear is at 0 Manoeuvres
5. Landing a Light While the Landing Gear is at 0 Manoeuvres

### 5 ON THE MACHINE WORKING

1. The Machine Working
2. Landing While at 0 Manoeuvres
3. Landing a Light While the Landing Gear is at 0 Manoeuvres
4. Landing a Light While the Landing Gear is at 0 Manoeuvres
5. Landing a Light While the Landing Gear is at 0 Manoeuvres

30 SUBJECTS ON DEMAND ONLY

THESE 17 TITLES  
WILL BE RELEASED SOON:

1. On the Machine Working
2. On the Machine Working
3. On the Machine Working
4. On the Machine Working
5. On the Machine Working
6. On the Machine Working
7. On the Machine Working
8. On the Machine Working
9. On the Machine Working
10. On the Machine Working
11. On the Machine Working
12. On the Machine Working
13. On the Machine Working
14. On the Machine Working
15. On the Machine Working
16. On the Machine Working
17. On the Machine Working

WITH  
U. S. OFFICE OF EDUCATION

## MOTION PICTURES that help to teach **MACHINE SHOP WORK!**

Now more than ever before, speed in the training of new workers is vital! You can accelerate your own training progress by the use of U. S. OFFICE OF EDUCATION training films!

Produced for the United States Government... for the specific purpose of aiding the nation's armaments program... these 16 mm Sound-on-Film motion pictures are accurate... authentic! They were made under the supervision of old line experts. Leading industries cooperated in their making. They contain no fluff or machine shop practice. They are LOW IN COST because the government wishes to use them as widely as possible.

Thousands of these training aids are in use right now, and these who have seen them call them one of the greatest contributions ever made to American industry and American workers.

Speed Victory by getting these motion pictures to work for your organization now! Without delay, write for complete information on price, length and subjects. Ask TODAY!

**CASTLE FILMS**

Distributor for THE UNITED STATES OFFICE OF EDUCATION

CASTLE FILMS	16A RUG	FIELD RUG	BASE RUG	Active
	NEW YORK	CHICAGO	SAN FRANCISCO	request
These are complete descriptions of all U. S. OFFICE OF EDUCATION Motion Pictures on Machine Shop Work. Now you can see the 16mm training aid for terms of Sale or Loan.				
From _____				
Address _____				
City _____ State _____				



## For LIGHT, STURDY, AND COMFORTABLE AIRCRAFT SEATING

**Nukraft**

IS NOW USED FOR THESE  
DEFENSE APPLICATIONS

- ★ Aircraft Pilot Seats and Backs
- ★ Aircraft Gunner Seats and Backs
- ★ Automobiles, Pads and Seats
- ★ Truck Seats and Backs
- ★ Officers' Chairs
- ★ Minepots, Boats
- ★ Bus Seats and Backs
- ★ Street Car Seats

Seats are comfortable—permanently—when they are cushioned with Nukraft. Made from sterilized hair, sprayed and dipped in a flexible binder, formed into figure 8 loops, and vulcanized—Nukraft always springs back up to shape no matter how often weight is applied. Thousands of hair springs cradle the weight... conform to every shift of the body... and will keep right on day after day maintaining comfort. Nukraft is light, impervious to water, durable—in fact a wholly desirable cushioning material for aircraft seating.

### NUKRAFT IS AVAILABLE IMMEDIATELY

Particularly important in these days, Nukraft is available immediately for aircraft seating. It is easy to use and responsive. Write today for full information about the advantages of Nukraft cushioning for you.

**NUKRAFT** MANUFACTURING COMPANY  
136 ALPINE ST. SHELBYVILLE, IND.



ON the occasion of the Airport visitation the maddening Southwester is scheduled to depart at 11:55 P.M. EST. It is now past 10:15, yet the great biplane ship has already been out of the hangar for close on an hour!

Where the team finally comes checks are withdrawn and the team begins their solo engine checkover for the take-off. A small gang of men, as observed, certainly will be working with surprising confidence, eyes from the shadow of the cockpit. These men are the "back-benders" and their job is a vital one. Check, test and double-check. Everything must be just right. The

safety and efficiency of the ship is only gained by long hours of searching toil.

It is the VOKES laboratory for more searching toil has been directed to the problem of filtration, and today for Vokes technicians have put their seal of satisfaction. The result of their research has been the introduction of an entirely different principle of filtration which gives the amazing percentage of 99.9% efficiency. This is an true perfection as it is possible for human endeavor to reach. These filters (possible for set and for high and low-pressure oil systems) filter down to particles 0.00004 in diameter.

The value of such absolute filtration cannot be overestimated. Here at last is pure oil—keeping constantly with these greater working efficiency, less wear and less trouble means less expense. No need be provided to remove all impurities through our system.



# VOKES

**VOKES LIMITED FILTRATION EXPERTS**  
 American and Canadian Agents:  
 E. Canfield, 100 Park Ave., New York

AVIATION, April, 1937

## aircraft instruments . . .

how to use them  
 how to test them  
 how to repair them  
 how to install them

*JUST OUT!*

GEORGE E. IRVIN'S

## AIRCRAFT INSTRUMENTS

THE full and explicit treatment presented in this book is in accordance throughout with manufacturers' recommended methods and surface procedures for all operations covered, and includes copyrighted information from these sources as well as working charts, formulas, tables, trouble-finding lists, etc., not heretofore available in a single book.

### Tells you all you need to know about:

metereological instruments	engine instruments	propeller and bank indicators
pressure gauges	compasses	vertical motion
thermometers	altimeters	gas flow
standard pressure gauges	directional gyro	recording instruments of airplane instruments
temperature and speedometers	air-speed indicators	
fuel quantity gauges	mag. of clock indicators	
	altimeters	

326 pages  
 6 1/2 x 9 1/2  
 Illustrations  
**\$5.00**  
 SEE IT  
 10 DAYS



Published by

**McGraw-Hill**  
 BOOK COMPANY, INC.

McGraw-Hill Book Co., Inc., 1221 W. 42nd St., N. Y.  
 Send me Irvin's Aircraft Instruments by 10 days' examination on approval. In 10 days I will send you \$5.00, plus low extra postage to return book postpaid. (Postage paid on orders accompanied by remittance.)

Name \_\_\_\_\_  
 Address \_\_\_\_\_  
 City and State \_\_\_\_\_  
 Postbox \_\_\_\_\_  
 Country \_\_\_\_\_ Av. 6-10  
 (Check not an approval in U. S. and Canada only.)

AVIATION, April 1937





# Three things you should be sure of IF YOU FLY FOR THE C.A.P.!

THE WEATHER — YOUR DIRECTION — YOUR POSITION



## RCA AVIATION RADIO RECEIVER

TYPE 100-101

Most sensitive aviation radio of its class and power most easily to operate maintenance facilities in standard A.V. equipment. Slide on dashboard—an uncomplicated installation. Internal electronic tuning... built-in Loop Reactor—reflector means of Volume Control. Dual ear phone tubes—do the work of 1. Complete broadcast receiver frequencies, 195-400 kHz.

THE WEATHER, YOUR DIRECTION, AND YOUR POSITION are three things you must know for certain if you put your light plane on "patrol duty." The only complete answer is radio!

Picked out a "handful" one that consists in a standard A.M. instrument hole—and weighing only 3½ pounds with tubes—the RCA Type AVR-101 Aviation Radio Receiver is as trim a little receiver as you've ever seen... yet packed with the power you need to bring you weather re-

ports or the best signals on even your longest cross country. As for location—just add the RCA Direction Finding Loop Antenna Model AVA-131! You can take a bearing in a jiffy—or "home" on even a weak and distant radio signal!

Seasonal, too—the AVR-101, complete with tubes and batteries, will cost you only \$68.95, including Federal Excise Tax, at your RCA Aviation Radio Distributor's. Why not write out to the field and see how today?



RCA DIRECTION FINDING LOOP ANTENNA MODEL AVA-131—Full electronic shielding reduces unwanted precipitation static and makes the radio more sensitive especially on weak signals and in high noise level areas. Results: greater bearing more accurate bearings!



## FOR AVIATION RADIO

DANBURY, N. J.

# PROVED BY YEARS OF AIRCRAFT SERVICE OHMITE Rheostats, Resistors, Tap Switches



Ohmite Rheostats were the first to be used in aircraft—and have been Army ever since. Today, these Ohmite Rheostats are used in military and commercial airplanes in more than any other make.

BE RIGHT WITH  
★  
**OHMITE**  
Rheostats-Resistors  
Tap Switches

The service record of Ohmite products in all types of aircraft has proved their dependability for today's critical requirements. The special features of Ohmite Rheostats insure permanently smooth, trouble-free, close control. The unique, compact design of Ohmite Power Tap switches has made it possible to provide small size multi-point rotary selectors capable of carrying high currents. Ohmite wire-wound Resistors are known for their ability to stay accurate, dissipate heat

rapidly, prevent burnout and failure.

The wide range of types and sizes makes it easier to provide the right parts for each need. Items produced to Government specifications or engineered for you.

Send for Catalog and Manual No. 10. Complete helpful information on Ohmite products and engineering service. Write us company letterhead for your copy today.



OHMITE MANUFACTURING COMPANY, 2916 Elmwood Street, Chicago, U. S. A.

AVIATION, April, 1942

345

AIRCRAFT  
OUTPUT

# Zooms DESPATCH FURNACES

**Speed Production of  
Parts and Assemblies  
and Maintenance**

Despatch industrial furnace heat presses that do the heat treating work. They combine SPEED—ACCURATE TEMPERATURE CONTROL—UNIFORMITY in a diamond heat treating process to produce metal parts, precision instruments and aircraft parts at the rate of rapid assembly. There are several particular applications of Despatch furnaces in aircraft plants. They are also used, wherever needed, wherever heat treatment is needed for live carbon steel, high carbon steel, and alloy steel parts—aluminum alloy, magnesium alloy, brass and other non-ferrous castings, forgings, steels and alloys.

**QUICK ATTENTION - SPEEDY DELIVERY**  
at the right type of furnace to handle your particular heat treating work. WRITE, PHONE OR WIRE for a Despatch engineer to work out your specifications with you.

# DESPATCH

OVEN COMPANY MINNEAPOLIS, MINNESOTA



DESPATCH "BATCH TREAT" CONVEYOR TYPE FURNACE. HEAT TREATS 100 LBS. OF PARTS IN 10 MINUTES ON A 1000° F. SET.



DESPATCH "BATCH TREAT" CONVEYOR TYPE FURNACE. HEAT TREATS 100 LBS. OF PARTS IN 10 MINUTES ON A 1000° F. SET.



DESPATCH "BATCH TREAT" CONVEYOR TYPE FURNACE. HEAT TREATS 100 LBS. OF PARTS IN 10 MINUTES ON A 1000° F. SET.



DESPATCH "BATCH TREAT" CONVEYOR TYPE FURNACE. HEAT TREATS 100 LBS. OF PARTS IN 10 MINUTES ON A 1000° F. SET.



DESPATCH "BATCH TREAT" CONVEYOR TYPE FURNACE. HEAT TREATS 100 LBS. OF PARTS IN 10 MINUTES ON A 1000° F. SET.



## This NEW Cross-Country Trainer Has EVERYTHING...



For several months WACO has worked with Civilian Pilot Training Program operators, pilots and mechanics to equip this new model VKS-7F with everything needed for the CPTP cross-country instruction and instrument training.

Powered with the Continental W670-M engine... the same reliable series used in the

famous WACO UPF-7 secondary trainer... equipped with vacuum flaps, controllable propeller, and all required instruments and radio equipment—this new ship is ready to begin your cross-country program.

Due to priority requirements, we suggest that you anticipate your needs and wire your order immediately.

THE WACO AIRCRAFT COMPANY - TROY, OHIO - U.S.A.

# The Publishers of AEROSPHERE

THE INTERNATIONAL AERONAUTICAL AUTHORITY

announce a limited

## FIVE YEAR SUBSCRIPTION PLAN

Our unprecedented Five Year Plan is restricted to 1000 exclusively numbered volumes. It comes to you as a result of the tremendous demand for our latest key note, up-to-date engineering and aeronautics information the world over for the notable work AEROSPHERE has done, and will continue to do you also pay for the published record of the world's progress.

The fact that aviation, engine and equipment manufacturers, military and government officials and individuals in all walks of life touched by the far-reaching effects of aviation now use AEROSPHERE daily is a testimony to the vast importance of the services the editors of AEROSPHERE perform. Your possession of an exclusively numbered copy, each year as issued, is a tribute to your part in the memorable labors of the air men through modern

history and a point of pride that will be treasured by you by year as the future history of aeronautics unfolds before you in your own personal AEROSPHERE library.

Here is what you receive when you are numbered among the 1000 subscribers to the Five Year Plan (starting with AEROSPHERE #1942): 1) Your copy, under the limited subscription, will be exclusively numbered, the same number to be used each year. 2) Your copy will be personally autographed by the Editor. 3) Your name will be stamped on the front cover of each copy. 4) Subscribers will receive the full copies printed before any general issue to the public. The order of receipt of your publications\* will determine a lot your number will be and since it will be privileged to continue under the same number.



The following is a list of the chronological order of publication of the Five Year Plan and is intended to be received as a guide to a group of AEROSPHERE volumes.

1) We hereby stamp your 5 Year Plan for \$45 and on demand full money order.

Received your most generous offer to make out No. 421 in your published list of 1000 numbers in advance for the new 5 Year Plan and was accordingly placed in the honor accorded you.

We wish to see check in the amount of \$45 for a 5 year subscription. *Leading Pacific Coast branch: Minneapolis*

We'll be pleased to have you enter my subscription in the list.

If you will send us a bill for \$45 for 5 years we will continue under the same number.

You may cancel our subscription order for the 1942 AEROSPHERE (beginning LE 1942 5-01-1942) and substitute the 5 Year Plan.

This library will now remain yours in every all your own.

I have had much pleasure from AEROSPHERE since I began receiving it with much interest in the future of the aviation industry.



### THREE YEAR PLAN

This plan offers you the advantage of substantial savings three years of the regular volume of AEROSPHERE starting with AEROSPHERE #1942 for \$15. (For example the 1942 AEROSPHERE on publication will be \$12.50 and three copies, because of war conditions, probably more.)

### AEROSPHERE #1942

Pre-publication rates are \$10 with your order, \$11 if paid on delivery. On publication, \$12.50. This volume, now in preparation, will bring up to date the sections on Aircraft, Aircraft Engines, Statistics and Buyer's Guide and will contain various new features including a section on all phases of Aircraft Armament. AEROSPHERE #1942 will not appear until July, and maybe later.

### Present Printings Available

- 1) AEROSPHERE #1941 — A low key, series of this important first volume (Published May 16, 1941) may be had in complete your attached library. This volume contains the standard four sections and features: on Engine series (pages 1-47) aircraft engine (pages 48-100) in 1940 (101-150 engine development) and various other material. Receiving a 1941-1942 \$15 flat shipping charge.
- 2) AEROSPHERE #1940 — Contains the most complete and authoritative statistical material. Contains the world's MODERN AIRCRAFT with 120 pages, 55 photographs and drawings (1-112 models). MODERN AIRCRAFT ENGINES with 140 pages, 200 photographs and drawings of 536 models. 142 pages of STATISTICS. REVENUE GUIDE with 1939-40, 4-10, 1940-41, 1941-42, 1942-43, 1943-44, 1944-45, 1945-46, 1946-47, 1947-48, 1948-49, 1949-50, 1950-51, 1951-52, 1952-53, 1953-54, 1954-55, 1955-56, 1956-57, 1957-58, 1958-59, 1959-60, 1960-61, 1961-62, 1962-63, 1963-64, 1964-65, 1965-66, 1966-67, 1967-68, 1968-69, 1969-70, 1970-71, 1971-72, 1972-73, 1973-74, 1974-75, 1975-76, 1976-77, 1977-78, 1978-79, 1979-80, 1980-81, 1981-82, 1982-83, 1983-84, 1984-85, 1985-86, 1986-87, 1987-88, 1988-89, 1989-90, 1990-91, 1991-92, 1992-93, 1993-94, 1994-95, 1995-96, 1996-97, 1997-98, 1998-99, 1999-00, 2000-01, 2001-02, 2002-03, 2003-04, 2004-05, 2005-06, 2006-07, 2007-08, 2008-09, 2009-10, 2010-11, 2011-12, 2012-13, 2013-14, 2014-15, 2015-16, 2016-17, 2017-18, 2018-19, 2019-20, 2020-21, 2021-22, 2022-23, 2023-24, 2024-25, 2025-26, 2026-27, 2027-28, 2028-29, 2029-30, 2030-31, 2031-32, 2032-33, 2033-34, 2034-35, 2035-36, 2036-37, 2037-38, 2038-39, 2039-40, 2040-41, 2041-42, 2042-43, 2043-44, 2044-45, 2045-46, 2046-47, 2047-48, 2048-49, 2049-50, 2050-51, 2051-52, 2052-53, 2053-54, 2054-55, 2055-56, 2056-57, 2057-58, 2058-59, 2059-60, 2060-61, 2061-62, 2062-63, 2063-64, 2064-65, 2065-66, 2066-67, 2067-68, 2068-69, 2069-70, 2070-71, 2071-72, 2072-73, 2073-74, 2074-75, 2075-76, 2076-77, 2077-78, 2078-79, 2079-80, 2080-81, 2081-82, 2082-83, 2083-84, 2084-85, 2085-86, 2086-87, 2087-88, 2088-89, 2089-90, 2090-91, 2091-92, 2092-93, 2093-94, 2094-95, 2095-96, 2096-97, 2097-98, 2098-99, 2099-00, 2100-01, 2101-02, 2102-03, 2103-04, 2104-05, 2105-06, 2106-07, 2107-08, 2108-09, 2109-10, 2110-11, 2111-12, 2112-13, 2113-14, 2114-15, 2115-16, 2116-17, 2117-18, 2118-19, 2119-20, 2120-21, 2121-22, 2122-23, 2123-24, 2124-25, 2125-26, 2126-27, 2127-28, 2128-29, 2129-30, 2130-31, 2131-32, 2132-33, 2133-34, 2134-35, 2135-36, 2136-37, 2137-38, 2138-39, 2139-40, 2140-41, 2141-42, 2142-43, 2143-44, 2144-45, 2145-46, 2146-47, 2147-48, 2148-49, 2149-50, 2150-51, 2151-52, 2152-53, 2153-54, 2154-55, 2155-56, 2156-57, 2157-58, 2158-59, 2159-60, 2160-61, 2161-62, 2162-63, 2163-64, 2164-65, 2165-66, 2166-67, 2167-68, 2168-69, 2169-70, 2170-71, 2171-72, 2172-73, 2173-74, 2174-75, 2175-76, 2176-77, 2177-78, 2178-79, 2179-80, 2180-81, 2181-82, 2182-83, 2183-84, 2184-85, 2185-86, 2186-87, 2187-88, 2188-89, 2189-90, 2190-91, 2191-92, 2192-93, 2193-94, 2194-95, 2195-96, 2196-97, 2197-98, 2198-99, 2199-00, 2200-01, 2201-02, 2202-03, 2203-04, 2204-05, 2205-06, 2206-07, 2207-08, 2208-09, 2209-10, 2210-11, 2211-12, 2212-13, 2213-14, 2214-15, 2215-16, 2216-17, 2217-18, 2218-19, 2219-20, 2220-21, 2221-22, 2222-23, 2223-24, 2224-25, 2225-26, 2226-27, 2227-28, 2228-29, 2229-30, 2230-31, 2231-32, 2232-33, 2233-34, 2234-35, 2235-36, 2236-37, 2237-38, 2238-39, 2239-40, 2240-41, 2241-42, 2242-43, 2243-44, 2244-45, 2245-46, 2246-47, 2247-48, 2248-49, 2249-50, 2250-51, 2251-52, 2252-53, 2253-54, 2254-55, 2255-56, 2256-57, 2257-58, 2258-59, 2259-60, 2260-61, 2261-62, 2262-63, 2263-64, 2264-65, 2265-66, 2266-67, 2267-68, 2268-69, 2269-70, 2270-71, 2271-72, 2272-73, 2273-74, 2274-75, 2275-76, 2276-77, 2277-78, 2278-79, 2279-80, 2280-81, 2281-82, 2282-83, 2283-84, 2284-85, 2285-86, 2286-87, 2287-88, 2288-89, 2289-90, 2290-91, 2291-92, 2292-93, 2293-94, 2294-95, 2295-96, 2296-97, 2297-98, 2298-99, 2299-00, 2300-01, 2301-02, 2302-03, 2303-04, 2304-05, 2305-06, 2306-07, 2307-08, 2308-09, 2309-10, 2310-11, 2311-12, 2312-13, 2313-14, 2314-15, 2315-16, 2316-17, 2317-18, 2318-19, 2319-20, 2320-21, 2321-22, 2322-23, 2323-24, 2324-25, 2325-26, 2326-27, 2327-28, 2328-29, 2329-30, 2330-31, 2331-32, 2332-33, 2333-34, 2334-35, 2335-36, 2336-37, 2337-38, 2338-39, 2339-40, 2340-41, 2341-42, 2342-43, 2343-44, 2344-45, 2345-46, 2346-47, 2347-48, 2348-49, 2349-50, 2350-51, 2351-52, 2352-53, 2353-54, 2354-55, 2355-56, 2356-57, 2357-58, 2358-59, 2359-60, 2360-61, 2361-62, 2362-63, 2363-64, 2364-65, 2365-66, 2366-67, 2367-68, 2368-69, 2369-70, 2370-71, 2371-72, 2372-73, 2373-74, 2374-75, 2375-76, 2376-77, 2377-78, 2378-79, 2379-80, 2380-81, 2381-82, 2382-83, 2383-84, 2384-85, 2385-86, 2386-87, 2387-88, 2388-89, 2389-90, 2390-91, 2391-92, 2392-93, 2393-94, 2394-95, 2395-96, 2396-97, 2397-98, 2398-99, 2399-00, 2400-01, 2401-02, 2402-03, 2403-04, 2404-05, 2405-06, 2406-07, 2407-08, 2408-09, 2409-10, 2410-11, 2411-12, 2412-13, 2413-14, 2414-15, 2415-16, 2416-17, 2417-18, 2418-19, 2419-20, 2420-21, 2421-22, 2422-23, 2423-24, 2424-25, 2425-26, 2426-27, 2427-28, 2428-29, 2429-30, 2430-31, 2431-32, 2432-33, 2433-34, 2434-35, 2435-36, 2436-37, 2437-38, 2438-39, 2439-40, 2440-41, 2441-42, 2442-43, 2443-44, 2444-45, 2445-46, 2446-47, 2447-48, 2448-49, 2449-50, 2450-51, 2451-52, 2452-53, 2453-54, 2454-55, 2455-56, 2456-57, 2457-58, 2458-59, 2459-60, 2460-61, 2461-62, 2462-63, 2463-64, 2464-65, 2465-66, 2466-67, 2467-68, 2468-69, 2469-70, 2470-71, 2471-72, 2472-73, 2473-74, 2474-75, 2475-76, 2476-77, 2477-78, 2478-79, 2479-80, 2480-81, 2481-82, 2482-83, 2483-84, 2484-85, 2485-86, 2486-87, 2487-88, 2488-89, 2489-90, 2490-91, 2491-92, 2492-93, 2493-94, 2494-95, 2495-96, 2496-97, 2497-98, 2498-99, 2499-00, 2500-01, 2501-02, 2502-03, 2503-04, 2504-05, 2505-06, 2506-07, 2507-08, 2508-09, 2509-10, 2510-11, 2511-12, 2512-13, 2513-14, 2514-15, 2515-16, 2516-17, 2517-18, 2518-19, 2519-20, 2520-21, 2521-22, 2522-23, 2523-24, 2524-25, 2525-26, 2526-27, 2527-28, 2528-29, 2529-30, 2530-31, 2531-32, 2532-33, 2533-34, 2534-35, 2535-36, 2536-37, 2537-38, 2538-39, 2539-40, 2540-41, 2541-42, 2542-43, 2543-44, 2544-45, 2545-46, 2546-47, 2547-48, 2548-49, 2549-50, 2550-51, 2551-52, 2552-53, 2553-54, 2554-55, 2555-56, 2556-57, 2557-58, 2558-59, 2559-60, 2560-61, 2561-62, 2562-63, 2563-64, 2564-65, 2565-66, 2566-67, 2567-68, 2568-69, 2569-70, 2570-71, 2571-72, 2572-73, 2573-74, 2574-75, 2575-76, 2576-77, 2577-78, 2578-79, 2579-80, 2580-81, 2581-82, 2582-83, 2583-84, 2584-85, 2585-86, 2586-87, 2587-88, 2588-89, 2589-90, 2590-91, 2591-92, 2592-93, 2593-94, 2594-95, 2595-96, 2596-97, 2597-98, 2598-99, 2599-00, 2600-01, 2601-02, 2602-03, 2603-04, 2604-05, 2605-06, 2606-07, 2607-08, 2608-09, 2609-10, 2610-11, 2611-12, 2612-13, 2613-14, 2614-15, 2615-16, 2616-17, 2617-18, 2618-19, 2619-20, 2620-21, 2621-22, 2622-23, 2623-24, 2624-25, 2625-26, 2626-27, 2627-28, 2628-29, 2629-30, 2630-31, 2631-32, 2632-33, 2633-34, 2634-35, 2635-36, 2636-37, 2637-38, 2638-39, 2639-40, 2640-41, 2641-42, 2642-43, 2643-44, 2644-45, 2645-46, 2646-47, 2647-48, 2648-49, 2649-50, 2650-51, 2651-52, 2652-53, 2653-54, 2654-55, 2655-56, 2656-57, 2657-58, 2658-59, 2659-60, 2660-61, 2661-62, 2662-63, 2663-64, 2664-65, 2665-66, 2666-67, 2667-68, 2668-69, 2669-70, 2670-71, 2671-72, 2672-73, 2673-74, 2674-75, 2675-76, 2676-77, 2677-78, 2678-79, 2679-80, 2680-81, 2681-82, 2682-83, 2683-84, 2684-85, 2685-86, 2686-87, 2687-88, 2688-89, 2689-90, 2690-91, 2691-92, 2692-93, 2693-94, 2694-95, 2695-96, 2696-97, 2697-98, 2698-99, 2699-00, 2700-01, 2701-02, 2702-03, 2703-04, 2704-05, 2705-06, 2706-07, 2707-08, 2708-09, 2709-10, 2710-11, 2711-12, 2712-13, 2713-14, 2714-15, 2715-16, 2716-17, 2717-18, 2718-19, 2719-20, 2720-21, 2721-22, 2722-23, 2723-24, 2724-25, 2725-26, 2726-27, 2727-28, 2728-29, 2729-30, 2730-31, 2731-32, 2732-33, 2733-34, 2734-35, 2735-36, 2736-37, 2737-38, 2738-39, 2739-40, 2740-41, 2741-42, 2742-43, 2743-44, 2744-45, 2745-46, 2746-47, 2747-48, 2748-49, 2749-50, 2750-51, 2751-52, 2752-53, 2753-54, 2754-55, 2755-56, 2756-57, 2757-58, 2758-59, 2759-60, 2760-61, 2761-62, 2762-63, 2763-64, 2764-65, 2765-66, 2766-67, 2767-68, 2768-69, 2769-70, 2770-71, 2771-72, 2772-73, 2773-74, 2774-75, 2775-76, 2776-77, 2777-78, 2778-79, 2779-80, 2780-81, 2781-82, 2782-83, 2783-84, 2784-85, 2785-86, 2786-87, 2787-88, 2788-89, 2789-90, 2790-91, 2791-92, 2792-93, 2793-94, 2794-95, 2795-96, 2796-97, 2797-98, 2798-99, 2799-00, 2800-01, 2801-02, 2802-03, 2803-04, 2804-05, 2805-06, 2806-07, 2807-08, 2808-09, 2809-10, 2810-11, 2811-12, 2812-13, 2813-14, 2814-15, 2815-16, 2816-17, 2817-18, 2818-19, 2819-20, 2820-21, 2821-22, 2822-23, 2823-24, 2824-25, 2825-26, 2826-27, 2827-28, 2828-29, 2829-30, 2830-31, 2831-32, 2832-33, 2833-34, 2834-35, 2835-36, 2836-37, 2837-38, 2838-39, 2839-40, 2840-41, 2841-42, 2842-43, 2843-44, 2844-45, 2845-46, 2846-47, 2847-48, 2848-49, 2849-50, 2850-51, 2851-52, 2852-53, 2853-54, 2854-55, 2855-56, 2856-57, 2857-58, 2858-59, 2859-60, 2860-61, 2861-62, 2862-63, 2863-64, 2864-65, 2865-66, 2866-67, 2867-68, 2868-69, 2869-70, 2870-71, 2871-72, 2872-73, 2873-74, 2874-75, 2875-76, 2876-77, 2877-78, 2878-79, 2879-80, 2880-81, 2881-82, 2882-83, 2883-84, 2884-85, 2885-86, 2886-87, 2887-88, 2888-89, 2889-90, 2890-91, 2891-92, 2892-93, 2893-94, 2894-95, 2895-96, 2896-97, 2897-98, 2898-99, 2899-00, 2900-01, 2901-02, 2902-03, 2903-04, 2904-05, 2905-06, 2906-07, 2907-08, 2908-09, 2909-10, 2910-11, 2911-12, 2912-13, 2913-14, 2914-15, 2915-16, 2916-17, 2917-18, 2918-19, 2919-20, 2920-21, 2921-22, 2922-23, 2923-24, 2924-25, 2925-26, 2926-27, 2927-28, 2928-29, 2929-30, 2930-31, 2931-32, 2932-33, 2933-34, 2934-35, 2935-36, 2936-37, 2937-38, 2938-39, 2939-40, 2940-41, 2941-42, 2942-43, 2943-44, 2944-45, 2945-46, 2946-47, 2947-48, 2948-49, 2949-50, 2950-51, 2951-52, 2952-53, 2953-54, 2954-55, 2955-56, 2956-57, 2957-58, 2958-59, 2959-60, 2960-61, 2961-62, 2962-63, 2963-64, 2964-65, 2965-66, 2966-67, 2967-68, 2968-69, 2969-70, 2970-71, 2971-72, 2972-73, 2973-74, 2974-75, 2975-76, 2976-77, 2977-78, 2978-79, 2979-80, 2980-81, 2981-82, 2982-83, 2983-84, 2984-85, 2985-86, 2986-87, 2987-88, 2988-89, 2989-90, 2990-91, 2991-92, 2992-93, 2993-94, 2994-95, 2995-96, 2996-97, 2997-98, 2998-99, 2999-00, 3000-01, 3001-02, 3002-03, 3003-04, 3004-05, 3005-06, 3006-07, 3007-08, 3008-09, 3009-10, 3010-11, 3011-12, 3012-13, 3013-14, 3014-15, 3015-16, 3016-17, 3017-18, 3018-19, 3019-20, 3020-21, 3021-22, 3022-23, 3023-24, 3024-25, 3025-26, 3026-27, 3027-28, 3028-29, 3029-30, 3030-31, 3031-32, 3032-33, 3033-34, 3034-35, 3035-36, 3036-37, 3037-38, 3038-39, 3039-40, 3040-41, 3041-42, 3042-43, 3043-44, 3044-45, 3045-46, 3046-47, 3047-48, 3048-49, 3049-50, 3050-51, 3051-52, 3052-53, 3053-54, 3054-55, 3055-56, 3056-57, 3057-58, 3058-59, 3059-60, 3060-61, 3061-62, 3062-63, 3063-64, 3064-65, 3065-66, 3066-67, 3067-68, 3068-69, 3069-70, 3070-71, 3071-72, 3072-73, 3073-74, 3074-75, 3075-76, 3076-77, 3077-78, 3078-79, 3079-80, 3080-81, 3081-82, 3082-83, 3083-84, 3084-85, 3085-86, 3086-87, 3087-88, 3088-89, 3089-90, 3090-91, 3091-92, 3092-93, 3093-94, 3094-95, 3095-96, 3096-97, 309

SOMEWHERE IN [REDACTED]...A SQUADRON  
OVERDUE...LOST...SEPARATED...OUT OF GAS  
AFTER HOURS OF FLIGHT...ALL MADE FORCED  
LANDINGS WITHIN RADIUS OF 10 MILES...

THAT'S

*Performance  
Consistency!*



THIS STOMBERG carburetor, featuring automatic mixture adjustment, is available in a wide variety of sizes and configurations to meet the needs of the aircraft engine manufacturer.

Fuel consumption is steady, predictable, and runs economically due to built-in fuel economy.

Other features of this modern carburetor are automatic mixture self-adjustment to proper fuel-air mixture for all altitudes, employing fixed size metering jets, very appreciable fuel economy, a constant vacuum on the engine's flying rings, and low capacity, simplification of field service work because of the virtually identical basic design used on various engine models.

BENDIX PRODUCTS DIVISION  
OF BENDIS AVIATION CORPORATION

**Stomberg**...A BENDIX PRODUCT  
**INJECTION CARBURETOR**

AVIATION, April 1942

**YOU CAN GET  
THE SHOP SET-UP YOU WANT — with**

**HOLLOWELL**

**SHOP FURNITURE OF  
STEEL**

• 1367 Bench combinations available in varying heights, lengths and widths to meet every normal and special shop need.

• A wide range of Tool Stands and Cabinets, Foreman's Desks, Stools, Chairs, Hand Trucks, Lift-Truck Platforms and Tote Pans for streamlined production efficiency.

• "Hollowell" Shop Furniture of Steel is famed for durability, refinement in design and attractive appearance. Built for long service, and utmost practical convenience of the user. And—prices are right.

• Send for Catalog today.

**STANDARD PRESSED STEEL CO.**

1000 WEST 10TH AVENUE, DENVER, CO.  
BRANCHES: CHICAGO, ILL. — ST. LOUIS, MO. — PHILADELPHIA, PA. — PITTSBURGH, PA. — RICHMOND, VA. — WASHINGTON, D.C. — WILMINGTON, DE.



Fig. 1367 Bench combination



Fig. 1317 Bench combination



Fig. 1317 Bench combination



Fig. 1317 Bench combination



Fig. 1317 Bench combination



Fig. 1317 Bench combination



Fig. 1317 Bench combination



Fig. 1317 Bench combination



Fig. 1317 Bench combination



Fig. 1317 Bench combination

AVIATION, April 1942

247





# Tannewitz

## HIGH SPEED BAND SAWS

A far faster  
means of  
cutting

SHEET  
STEEL  
NON-  
FERROUS  
METALS  
PLASTICS,  
ETC.

[See Chart  
Below]



These superb machines, built to deliver any speed up to two miles of saw blade travel per minute without vibration, are doing hundreds of multi-cutting and other jobs that is a fraction of the time previously required. In plants throughout the aviation industry. To insure production and make important savings in costs by all means invest your money, at once. A few requesting latest Cutting Band Saw Bulletin will bring you the complete facts promptly.

PERFECTLY SAFE Two-Wheel Locking Hydraulic Brakes automatically and instantly stop the wheels in case of saw blade breakage—completely guarded.

Many HIGHLY DEVELOPED, PATENTED FEATURES found in no other band saws are incorporated in TANNEWITZ HIGH SPEED BAND SAWS.

Built by  
Sawing Machinery Specialists

THE TANNEWITZ WORKS, GRAND RAPIDS, MICH.

## ★ POWER DIVE AT ★ *Zero Miles per Hour...*



... Testing Aircraft Fabrics  
for Tensile Strength

IN the Thurston Laboratories we "power dive" all fabrics on a tensile-strength recorder before we allow them to carry the AIRWING label.

It is a careful test, because vastly improved aircraft performance is making severe demands on the fabrics as we today. That is the reason why every specification is subjected to thorough testing in our Laboratories. When you see the AIRWING name on fabrics or tapes you can be certain of assured performance, guaranteed to exceed specification figures.

The famous AIRWING line includes surplus fabrics, balloon cloth, utility cloths. A complete selection of tapes comprises plinked edge and strangle tape, burring tapes and predoped tapes. AIRWING tapes are available in all widths, cut in our own factory.

If you insist on AIRWING Fabrics and Tapes, you can be certain of proved performance.



**W. HARRIS THURSTON**

• THURSTON CUTTING CORPORATION •

Head Office 48 Park Street, New York, N. Y., U. S. A.

Laboratory, Cutting Plant and Warehouse  
at 37 South St. New York 5, N. Y., U. S. A.

## For a Flexible D-C Power Supply use G-E RECTIFIERS



Your  
Modeling  
Of Two  
G-E  
"380" 's

Designed for maximum over-all  
efficiency for your electroplating and  
anodizing operations

General Electric Copper-Oxide Rectifiers are easily grouped in parallel to handle heavy current loads or in series to obtain higher voltage for special processes. They provide economical, dependable power sources... require practically no maintenance... can be added easily as your business expands. Investigate the savings possible with G-E Rectifiers. Write today to Rectifier Sales, Section A-2844, General Electric Company, Bridgeport, Conn.

**GENERAL ELECTRIC**

## THE PROOF OF THE PUDDING!

Every day we receive requests from the Aviation Industry for men we have trained to do specific jobs.

This proves that the instruction provided at ROOSEVELT AVIATION SCHOOL meets all the requirements of the industry.

**SUMMER CLASSES  
START JULY 6, 1942**

**AVIATION TRAINING AT ITS BEST**

**SIGN AND MAIL COUPON TODAY**

ROOSEVELT AVIATION SCHOOL

at Roosevelt Field, Mineola, Long Island, N. Y.

(Without obligating you, send details of course desired)

☐ COMMERCIAL PILOT ☐ COMMERCIAL PILOT MECHANIC  
☐ PRIVATE PILOT ☐ AIRPLANE A & ENGINE MECHANIC

Name  Age

Street Address

City  State  Zip



Consistent Time and Work Savings

## as DE-BURRING and FINISHING OPERATIONS with **Brightboy**

**The RUBBER-4 UNBIONED ABRASIVE MATERIAL for Hand and Machine Work. Not a Buff. Not a Grind.**

Now used by America's leading airplane and parts manufacturing for work on engines, accessories and instruments, propellers, fuselages, assemblies, aluminum, stainless steel and other metals to be welded, soldered, finished. In one operation, Brightboy will deburr, polish and put on a slight radius.

**BRIGHTBOY** is an elastic rubber compound impregnated with abrasives. It reproduces a new time and work saving principle in polishing and finishing operations. It allows the abrasive reaction into the material being treated, leaving free at the binder as worn away. Minimum economical loss of the material to which it is used.

Keeps clean, economical to use. No tracing or expensive machinery. A wide variety of shapes for a wide variety of uses—tablets and sticks for hand work; wheels for stationary, portable and flexible shaft, electric and pneumatic grinding, finishing and buffing machines. No special shaping or preparation. All shapes and sizes ready for immediate use.

Ask your oil supply dealer for prices, sizes. If you cannot obtain prompt information or delivery from your regular supply sources, give us details of your requirements and we will send you complete illustrated catalog and prices.

**BRIGHTBOY INDUSTRIAL DIVISION**  
WELDON ROBERTS RUBBER CO. Newark, New Jersey

\*Minimum order 100 lbs.



**WELDON ROBERTS**  
**Brightboy**

The **SOFT RUBBER** binder  
**CUSHIONS** the abrasive

## HERE'S YOUR NEW GUIDE



### TO BETTER USE OF ELECTRICAL CONTROL

#### COMPLETE CATALOG OF RELAYS AND ELECTRICAL CONTROL APPARATUS



If the products you are building for the war effort call for the use of relays, tapping switches, keys or other electrical control devices, this book is a "must" run for you. It includes many helpful data and a greater variety of good facts than you will find anywhere else under a single cover.

More important still, it lists the products of the pioneer organization in the electrical control field, the company which originated the automatic telephone and has adapted electrical control

units and principles to many conceivable types of business.

Write for your copy of this new book today. It will not only save you time and money, but will also help you improve your products.

**AMERICAN AUTOMATIC ELECTRICAL SALES COMPANY**  
1803 W. Van Ness Street, Chicago 6, Ill.

**AUTOMATIC ELECTRICAL**

RELAY MAKERS SINCE 1898



### THE BOOK FOR ALL WHO WANT TO BECOME accomplished aircraft layout and design draftsmen



**JUST  
Out!**

Without spending a single word on unnecessary detail, this book shows the plotting and ready-how to make layout and design many airplane parts and things that may be made efficiently and economically in the shop. Ample and to choose for every class of work, are 200 step-by-step drawings, carefully prepared, fully drawn, filled with illustration, problems and solutions, references, etc.

### Aircraft Layout and Detail Design

By **Newton H. Anderson**,  
Project Director of Education Department,  
Douglas Aircraft Company, Inc.  
366 pages 6 1/2 x 9 1/2 inches. \$1.00

Covering the three main subjects with which every aircraft layout draftsman must be familiar: descriptive geometry, detail design and fitting analysis, this book gives you:

- explanatory premises on layout, why and how they are made, with information they should contain; on
- descriptive geometry and its application to various types of detail design;
- engineering in the design and specification of parts, materials, joints, bearings, and fasteners;
- general features of fitting, cutting, and other fabrication processes as they affect detail design;
- mechanisms of these systems as applied to detail design;
- methods and examples of calculating bending and structural stresses, making strength calculations for riveted and bolted joints, stress and strains, and designing data with losses.

SEE IT 10 DAYS—MAIL THE COUPON

**MCGRAW-HILL**  
**ON-APPROVAL COUPON**

McGraw-Hill, Book Company, Inc.  
1221 Ave. of the Americas, New York, N. Y.  
Send me for 10 days examination, nothing to be paid, a complete, detailed, and useful book, "Aircraft Layout and Detail Design," by Newton H. Anderson, 366 pages, 6 1/2 x 9 1/2 inches, 200 step-by-step drawings, fully drawn, filled with illustration, problems and solutions, references, etc. (This coupon is not valid unless accompanied by a check or money order.)

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City and State \_\_\_\_\_  
Profession \_\_\_\_\_  
Company \_\_\_\_\_  
(Circle zero or opposite to be filled in if not desired)

**Boeing**  
**FLYING FORTRESSES**



### For America's Victory

Mighty monarchs of the air, the Boeing Flying Fortresses, equipped with Witeck Aviation Hose Clamps, are coming off the production lines in ever increasing numbers for the protection of American soil and the American way of living.

Proved by use in service, Witeck Aviation Hose Clamps are standard equipment of aircraft manufacturers and engine builders, and the standard replacement clamp of the industry.

### THE STANDARD OF THE INDUSTRY



## Compressor Capacity S-T-R-A-I-N-E-D to the Limit?



## NOPAK Leakproof Valves Can Give It A Lift!

Before you invest in an additional compressor, give your present equipment a chance to deliver its full rated capacity. Now! First, replace all worn, leaky, outworn, shut-off or operating valves with NOPAK Valves. Second, check air lines for leaks at all joints and unions. Remember, one tiny air leak can waste \$20.00 to \$25.00 worth of compressed air in a month!

After taking these steps to fully pressure test, you'll notice a substantial increase in compressor capacity plus a worthwhile saving in air costs. Yet, you gain these benefits at only a fraction of the cost of an extra compressor.

NOPAK Valves are leakproof, as well as leak-proof. Have no packing to disintegrate, require no packing replacement, save maintenance expense. What's more, we can ship illustrated types, in all sizes, immediately.

**GALLAND-HENNING MANUFACTURING CO.**  
3748 W. 4th St. East • Milwaukee, Wisconsin



NOPAK Valve Type 1 and 2 in various finishes.



NOPAK Valve Type 3 and 4 in various finishes.



NOPAK Valve Type 5 and 6 in various finishes.

**NOPAK** Recommendations by National Oil  
**VALVES and CYLINDERS**  
DESIGNED BY DR. H. G. HYDROLYSIS SYSTEMS

## NOW— SENSATIONAL NEW— TYPE PHOTOCOPY PAPERS For All Kinds of CONTACT COPYING!

Now get address change forms printed in minutes! Labels, business cards, stationery, and more with a minimum of effort and cost. The new type photocopy papers are available in a variety of sizes and weights. They are made of high quality paper and are completely resistant to fading and discoloration. They are also resistant to water and oil. They are available in a variety of colors and finishes. They are also available in a variety of sizes and weights. They are made of high quality paper and are completely resistant to fading and discoloration. They are also resistant to water and oil. They are available in a variety of colors and finishes. They are also available in a variety of sizes and weights.

## Approved FOR SAFETY and DEPENDABILITY

**Justrite Safety Cans**  
Approved, impact and individually test rated and tested by Underwriters Laboratories Inc. That means they provide the SAFEST way to store and handle flammable and combustible liquids. And they're built to last—change (and repair) small double vented and welded—tested standard tanks. They're built to last—change (and repair) small double vented and welded—tested standard tanks. They're built to last—change (and repair) small double vented and welded—tested standard tanks.

**Justrite Two-Ball Electric Lantern**  
Approved by Underwriters Laboratories Inc. for use in hazardous locations. Class 1, Group D listed for industrial use and no open flame. Light for power and safety. Powerful 114 double power filament lamps plus built-in safety. Two balls replace design of high beam—top of the work light acted built-in safety. Recharge built-in power of service.

Ask your dealer or write direct for catalog of Justrite Safety Products  
**Justrite Manufacturing Company**  
3946 S. Broadway Ave., Chicago, Ill.

## CONTROLS FOR HEATED FLYING SUITS

The new type of heated flying suit is now available. It is made of high quality material and is completely resistant to fading and discoloration. It is also resistant to water and oil. It is available in a variety of colors and finishes. It is also available in a variety of sizes and weights.

## WARD LEONARD

General Electric Co. Division of GE  
11 South Street, New York 14, N.Y.

## Best preparation for an aircraft industry job!

The latest single group of men in most aircraft plants consists of those who handle sheetmetal. And here, in this book, is the simplest, yet most complete manual for all who want to start this work or improve in it. Shop terms, plan reading, layout, tools, material, methods—all that is needed to start even the novice in sheetmetal work, and give him practical ability, in hours.

## Just Out! How to Do Aircraft Sheetmetal Work

By CAR HENNING  
Manufacturing Editor, Aviation  
and JAMES D. GIBSON, Jr.  
Lieut. (jg), U.S.N.F., 3d Group  
Grand Island, U.S. Naval Air Station, N.Y.  
No. 1001, 1st St. 212, New York, N.Y.

Here is a concise, practical course, telling you how to lay out work and cut, form, and join sheet metal parts used in airplane manufacture and repair. Shows how to make and use templates, how to measure the work from drawings to metal, gives clear, clear instructions on the various steps of joining sheet metals, including spot welding, also the use of jigs in assembly and the special techniques of skin fitting. Fundamentals such as blueprint reading and shop mathematics are included, and review questions and practice projects are given.



**MAIL THIS COUPON**

**McGraw-Hill**  
**COLLATERAL COUPON**

McGraw-Hill, 1221 Avenue of the Americas, New York 10, N.Y.  
Send me the 1st copy of this book, entitled "How to Do Aircraft Sheetmetal Work" for \$1.00. I will pay for the balance of the book in 10 equal payments of \$1.00 each, payable on the 1st of each month for 10 months. (We pay postage on orders shipped by express.)

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City and State \_\_\_\_\_  
Postoffice \_\_\_\_\_  
Country \_\_\_\_\_

# RBC

## NEEDLE BEARINGS

Carry Heavy Loads in  
LANDING GEAR  
WING FLAPS  
BOMB BAY DOOR  
OPERATING MECHANISMS

ROLLER BEARING  
COMPANY  
OF AMERICA

PHILADELPHIA • NEW JERSEY



## REZTOR GAS FIRED UNIT HEATERS

For "ALL OUT"  
INDUSTRIES



**SAVE**—days and on millions  
works on installation and  
for installing Reztor Gas  
Unit Heaters. The unit is  
small, portable and  
operates on gas, oil or  
kerosene. Only a gas line  
and a vent pipe are re-  
quired. Compared with  
other radiation systems,  
Reztor heaters are effi-  
cient, safe and reliable.  
See your dealer for more  
information. Send for order  
form of Reztor's literature  
now.

REZTOR MANUFACTURED BY  
420 JAMES STREET  
MILWAUKEE, WISCONSIN

"GAS HEATERS EXCLUSIVELY SINCE 1908"



### PRIORITY IN EXPERIENCE

Our facilities for manufacturing special tools, cranks, screws and other odd-sized products have long been utilized by the aircraft industry. We pioneered in your field aluminum alloys.

As a result of this experience we are thoroughly familiar with the delivery of the necessary precision delivery status. We turn to your business and deliver. Call us on request. No obligation.



**JOHN HASSALL, INC.** 112 CLAY STREET  
NEW YORK, N. Y.



# B \* A \* 30

See Your Dealer

B \* A \* 30 airplane wing clark, famous for its uniformity, is lighter, stronger and more closely woven than other aerial fabrics.

**WELLINGTON SEARS COMPANY**  
45 WORTH STREET NEW YORK CITY

## Remember the name: "IRVIN"



The name "IRVIN" on the harness means the chute is produced in an Irvin factory with over 30 years of experience built into it.

Used by Allied Air Forces in all parts of the world.

Literature can be had by school executives for the making. Address: Main Office in Buffalo, N. Y.

**IRVING AIR CHUTE CO., INC.**  
1630 Jefferson Ave., Buffalo, N. Y.

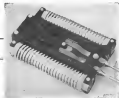
Factories at Buffalo, N. Y.; Chicago, Illinois; Fort Worth, Texas; Los Angeles, California; Honolulu, Hawaii; and other locations.

# IRVIN

## Air Chutes

SERVING OVER 40 GOVERNMENT AIR FORCES

## Automatic Regulation of Control Cable Tension



Sturgess  
Cable Tension Regulator  
Is  
Simple—Rugged—  
Without Extra Weight—  
Effective

The answer to nearly every problem is simple—when it has been found. There is precision work in this Sturgess Regulator—there are two years of experimentation, tests, and refinement—but the result is a unit of comparatively few moving parts, strong to an ample safety margin—ready to do a new and important job—well!

## PACIFIC SCIENTIFIC COMPANY

Aircraft Accessories Since 1923

Address Inquiries to:

1430 Grandview Avenue  
San Francisco, California

2110 Broadway Street  
San Francisco, California

# Aircraft STRUCTURAL VENEERS

• Penock and National veneers combine extra-strength in cutting with improved methods of handling and inspection that insure a full and untroubled aircraft production and the closest adherence to the industry's standards. As premier producers of aircraft veneers, we offer the following American woods—produced out to any thickness:

Ash  
Basswood  
Birch  
Elm  
Hard Maple

For further information, address:

**PENOCK VENEER COMPANY**  
MILWAUKEE, WISCONSIN

Ash  
Hard Maple  
Yellow Poplar  
Sitka Spruce  
American Walnut

For further information, address:

**NATIONAL VENEER & LUMBER CO.**  
AVIATION DIVISION • INDIANAPOLIS, INDIANA



A word of the bearing—precision production

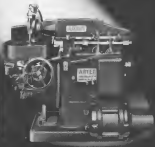
## ARTER ROTARY SURFACE GRINDERS

Overhaul faces, resurfacing roller clutch discs, valve gears, etc. precision ground on ARTER ROTARY SURFACE GRINDERS in step with today's high speed aircraft production program.

Great vertical capacity. Flexible work table. Free of wheel. Amazing magnetic chuck plates.

After engineering service for all surface grinding problems.

**ARTER GRINDING MACHINE CO.**  
WORCESTER, MASS., U. S. A.



## BOTH ENGINES AND PROPELLERS CONTAIN BROKIE PARTS BY **AMPCO**

IN all combat planes—fighters and bombers of both services—engine and propeller parts made of Ampco Metal, that alloy of the aluminum bronze class, give increased operating life under severe flight conditions.

Other aircraft equipment—resonance locking gear and tail wheel assemblies, windmill rotors and other operating accessories are also Ampco-equipped. Aircraft designing engineers prefer Ampco bronze for longer life and maximum service.

Ampco Metal has the controlled quality, the high physical properties, and rugged strength that make it ideal for aircraft service. It is a metal that can "take it"—stand up against unusual stresses—and fill one of the aircraft industry's vital needs for combat service.

### Literature on Bronzes

Ask for Ampco Literature describing the use of Ampco in aircraft construction. Free on request.

**AMPCO METAL, INC.**

Dept. A-4

Milwaukee, Wisconsin



## Use **MERIAM** MANOMETERS for TESTING and CALIBRATING Aircraft Instruments

• To maintain the accuracy of Altimeters—Air Speed Indicators—Rate-of-Climb Indicators—Fuel Pressure Gauges—Manifold Pressure Gauges—Vacuum Gauges—Fuel Quantity Gauges and other aircraft instruments—check and calibrate them with Meriam Manometers.

Standard and special types of Meriam Manometers, reflecting the company's more than 30 years experience and outstanding leadership in building accurate indicating instruments, are used for checking and calibrating in all Army air fields in the United States and Possessions, and in Navy air field and training stations. They maintain measuring accuracy against which other gauges can be checked positively, and in addition are widely used in testing Carburetor Pressures—Air Flow—Absolute Back Pressures—Carburetor Pressure Drops—Engine Manifold Pressures—Supercharger Pressures—both in aircraft manufacturing and in engine, carburetor, pump and other parts manufacturing plants.

Our wide experience in this exacting calibrating and testing work is fully at your disposal. Do not hesitate to write us fully about your problems. We will endeavor to be of every possible assistance.

THE **MERIAM CO.**  
CLEVELAND, OHIO

Manometers,  
Gauges, and Gauges  
for the accurate  
measurement of Pressure, Vacuum and Flow of Liquids and Gases







**FLEXIBLE CABLE**—uses sliding member in thick-walled round steel spring, connected with strong electrical cable. Exposed to spring, wrapped, the steel round wire treated with talcum powder to resist gas, water and oil. Cable is permanently lubricated.

**WAVE SPRING**—endured friction against cable can be still in line and still work. The high stress in the closely wound tapered spring, even moving more lubricated and not heat foreign materials spray up as they slip for closer sliding contact cable.

WRITE FOR COMPLETE CATALOG  
For answers to all your questions and to all technical  
control problems.  
**ARENS CONTROLS, INC.**  
2217 S. Indiana Street • Chicago, Illinois



**When You Need  
Quick Action . . .**  
in Operation available  
or needed in America  
See  
The "MARRY FLAG"  
or  
AMERICAN

Published  
Each Month



**NO. 50 TYPE**  
The VERSATILE  
Jewel Light Assembly



**RECOGNIZED  
LEADERSHIP**

With the continuous fast development in the field of electronic equipment, the Drake Company has been able to produce a wide variety of electronic light assemblies. These assemblies are of the highest quality and are available in a wide variety of sizes and shapes to meet the needs of the aircraft industry.

**DRAKE MFG. CO., 1712 W. Hubbard St., Chicago, Ill.**  
Write for literature, data, prices, etc. to: Drake Mfg. Co., Chicago, Ill.

**PIERCE ELECTRONIC COMPANY, INC.**  
1000 N. Dearborn St., Chicago, Ill.

## There's News in the Advertising Pages

For the latest news of the products which are contributing to the rapid growth of flying.

Read the Advertising Pages of  
*Aviation* in this and every issue

Products advertised in AVIATION are reliable. Write advertisers for further information.

## AVIATION

(A McCREE PUBLICATION)  
310 W. 42nd Street New York, N. Y.

**Hindview MIRRORS**  
QUALITY-MADE FOR MORE  
THAN A QUARTER-CENTURY

**WHITEHEAD STAMPING CO.**  
155, 156 S. 10th St., Gary, Ind.

**RUSSELL AVIATION UNIFORMS**  
CAPS, DEVICES, INSIGNIA



Quality, Style, Service. Makers of uniforms and insignia for officers of U. S. Army & Navy for over 50 years. A line of our many products are: Dress C. P. T. and lower uniforms and dress uniforms, caps, insignia, buttons, ties, etc. (AMERICAN COLORED NORTHWEST NATIONAL SOLE LAMIA, AMERICAN EXPORT AIRCRAFT, etc.)

**RUSSELL UNIFORM COMPANY**  
1400 Broadway, N. Y.  
"The Firm with a National Reputation"

## WIND DRIVEN GENERATORS \* DIRECT-CRANKING STARTERS



Light—Strong—No pulley—Low priced—Custom generators, each with 1/2 hp motor. Fully enclosed units guaranteed for 12 months \$25 to \$50

**CHAMPION Aviation Products**  
1001 South Park Road • Los Angeles, California • Telephone 7-1111



If there is anything you want—or something you don't want that other readers of this paper can supply—or use—advise it in

## Aviation's Market Place

AVIATION "CLASSIFIED"



ESTABLISHED 1872



MARKET BAYTON ROAD 1910

**ALFRED PARTRIDGE & Co. LTD.**  
ENGINEERS  
ASHTON RD. BREDFORD, STOCKPORT, ENGLAND

We cordially invite correspondence with American & Canadian Manufacturers who are seeking an agent with Modern facilities and Service for effectively serving British markets. Long established and very successful clientele available. All kinds of previous national for large and small markets. Please WRITE

## WHERE TO BUY

NEW EQUIPMENT—ACCESSORIES—MAINTENANCE—SUPPLIES

## Delivery

VS.

## Delay...

It's your knowing where to find what you need in the deciding factor between DELIVERY and DELAY . . . a result of the advertising pages of AVIATION. If the advertisements do not tell where to find what you need . . . write

**AVIATION**

**STANDARD AIRCRAFT FINISHERS**  
Since 1910  
**TITANINE**  
TITANINE INC. UNION, N. J.



**ALLEN Flux**  
FOR STAINLESS STEEL  
For stainless steel, aluminum, copper, brass, etc. It is a flux for welding and brazing. It is a flux for welding and brazing. It is a flux for welding and brazing.



**FOR ENGRAVING, ACID-ETCHING, ELECTRIC MARKING**

... on Aircraft Parts

A compact precision bench type pantographic machine, with interchangeable heads . . . for engraving instrument dials, gauge plates, etc. . . and for acid etching or electrolytic marking of small engine parts—Best treated or untempered—on flat, convex, or concave surfaces.

Illustration shows machine with engraving head attached.

Write for literature  
**H. P. PREIS ENGRAVING MACHINE CO.**  
1000 SUMMIT ST. NEWARK, NEW JERSEY









# EXTRUDED TUBING • METALLIC BELLOWS •



## for COOLING and COOLING CONTROL of AIRCRAFT ENGINES

Oil Cooler Tubes  
Precision Radiator Tubes  
Intercooler Tubing  
Oil Thermostats  
Coolant Thermostats  
Bellows (Self-Seal)  
Supercharger Controls  
Carburetor Controls  
Manifold Gaskets  
Exhausts, etc.

HYDRON thin-wall extruded tubing is used in aircraft radiators, oil coolers, intercoolers, and heat interchangers, for liquid-cooled and air-cooled motors. HYDRON thin-wall hydraulically-formed metallic bellows are used in all types of temperature and pressure control devices for aircraft engine cooling systems, carburetors and superchargers.

# HYDRON

CLIFFORD MANUFACTURING COMPANY

564 EAST FIRST STREET, BOSTON

CHICAGO: 811 North LaSalle Street

DETROIT: 401 East River

AVIATION April 1942

# 20 years of Service Data!



Magnesium, the metal that saves more weight than any other in structural use, has acquired over 20 years of service data. Many industries, cooperating with Dow, the pioneer American producer of magnesium, have long since established it as a useful and essential metal. There is now a great bank of experience from which to draw.

The service data acquired is based on applications ranging from domestic applications, business machines and portable tools to airplanes and other uses of transportation. One of the earliest uses of magnesium castings in this country was on aircraft landing wheels. The use of magnesium for landing wheels

was begun in 1930. Today scores of aircraft parts are made from the metal. Dow receives from before and after a great new vitality essential to our wartime program.

This expanding experience will guide industry into many fresh fields and huge production will be available for an ever-increasing range of applications when peace returns.

**THE DOW CHEMICAL CO., MIDLAND, MICH.**

New York City • Los Angeles • Chicago • San Francisco  
San Diego • Seattle • Houston

\*From Stock Buy U. S. War Eff.



HIGHEST OF ALL STRUCTURAL METALS

# DOWMETAL MAGNESIUM

INGOT • CASTINGS • FORGINGS • SHEET • PIPE • PLATE • EXTRUSIONS

# KEEP 'EM FLYING!



VULTEE  
DIVE BOMBER

## ECLIPSE AVIATION

DIVISION OF BENDIX AVIATION CORPORATION

BENDIX, NEW JERSEY, U. S. A.

WITH

## *Eclipse* AIRCRAFT ACCESSORIES

**S**TRIKING with telling force, Dive Bombers have become one of the most effective and outstanding weapons of modern aerial warfare. As manufacturers of high performance trainers, pursuit ships and observation planes for the military services, Vultee Aircraft is well equipped to pioneer in the design and development of that newest of aerial weapons—the Dive Bomber.

Dive bombing technique, for high accuracy bombardment, was originally developed by the U. S. Air Services. Experts in the art of dive bombing, American airmen look to the Vultee Dive Bomber with confidence. Designed as one of the most dependable and efficient performers in its field, this newest of Vultee airplanes incorporates many aircraft accessories of Eclipse manufacture—units of tested workmanship with records of dependable service.

### *Eclipse Products used by Vultee Aircraft, Inc.*

Hand and Electric Inertia Starters, Direct Cranking Electric Starters, Direct Cranking Electric and Inertia Starters, Battery Booster Coils, Solenoid Engaging Devices, Solenoid Relays, Solenoid Circuit Breaker Switch, Engine Driven Generators, Control Boxes, Filter Boxes, Air Valves and Supercharger Regulators.



© 1942, Bendix Aviation Corp.

For Dependable Operation *IT PAYS TO* **FLY** Eclipse-Equipped